III B. Tech I Semester Regular Examinations, Dec/Jan -2022-23
GEOTECHNICAL ENGINEERING -I
(Civil Engineering)

Time: 3 hours   Max. Marks: 70

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

1. a) Define the following terms (i) Adsorbed water (ii) Diffused double layer [6M]
    b) What are the different types of soil structures which can occur in nature? Describe in brief the structures of fine-grained soils. [8M]

(OR)

2. a) What do you mean by Weathering? Explain how soils are formed by the weathering process. [7M]
    b) Explain in detail about the three clay minerals. [7M]

UNIT-II

3. a) Write the relationship between discharge velocity and seepage velocity and alsostate Darcy's law and derive its expression. [7M]
    b) Determine the average horizontal and vertical permeability coefficients of a soildeposit made up of three horizontal strata, each 1m thick, if the coefficients ofpermeability are 1×10^{-1} mm/s, 3×10^{-2} mm/s and 8×10^{-3} mm/s respectively for thethree layers. [7M]

(OR)

4. a) Explain the procedure of flow net construction with sketches. [7M]
    b) A falling head permeability test is performed on a soil sample whosecoefficient of permeability is 3×10^{-5} cm/s. What diameter of the standpipe shouldbe used if the head is to drop from 27.5cm to 20.0cm in 5 minutes and if the cross-sectional area and length of the sample are respectively 15cm^2 and 8.5cm? [7M]

UNIT-III

5. a) Write a brief critical note on 'Newmark's influence chart' [7M]
    b) Two concentrated loads of 500 kN and 900 kN are situated 5 m apart on the groundsurface. Find out the vertical stresses at 3.0 m below each load. [7M]

(OR)

6. a) A Newmark's chart was prepared with the influence coefficient of 0.005 with thedesired scale the stress concentrated area is drawn on tracing paper. Then the tracingpaper is placed on top of the influence chart with the desired position. Then the numberof sectors covered by the stress area is 31. Compute the stress at the given positionfor the desired stress area. Applied on the area is 200 kN/m^2. [8M]
    b) Compare and contrast Boussinesq's and Westergaard's theories? [6M]

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UNIT-IV

7. a) In a consolidation test, the following results have been obtained   [7M]
        when the load was changed from 50 kN/m^2 to 100 kN/m^2, the
        void ratio changed from 0.70 to 0.65. Determine the coefficient of
        volume decrease m_v and the compression index C_c.
    b) What are the assumptions made in Terzaghi's one-dimensional   [7M]
        consolidation theory?

<div align="center">(OR)</div>

8. a) Explain the effect of compaction on soil properties   [6M]

    b) A soil is to be excavated from a borrow pit which has a density of   [8M]
        1.75 g/cc and water content of 12%. The specific gravity of solid
        particles is 2.7. The soil is to be compacted to a water content of
        18% and dry density of 1.65 g/cc. For 1000 m^3 of soil in fill
        estimate
        (i) Quantity of soil to be excavated from the pit in m^3
        (ii) Amount of water to be added to increase the water content
        from 12% to 18%

UNIT-V

9. a) A shear vane of 7.5 cm in diameter and 11.0 cm in length was   [9M]
        used to measure the shear strength of soft clay. If a torque of
        600 N-m was required to shear the soil, Calculate the shear
        strength of the soil. The vane was rotated rapidly to cause
        remoulding of the soil. The torque required in the remoulded
        state was 200 N-m. Determine the sensitivity of the soil.
    b) Explain the stress-strain behavior of clays   [5M]

<div align="center">(OR)</div>

10. a) Explain the shear strength of sands with suitable examples.   [5M]
    b) In a drained triaxial compression test, a saturated specimen of   [9M]
        cohesionless sand fails under deviator stress of 5.35 kg/cm^2.
        When the cell pressure is 1.5 kg/cm^2. Find the effective angle of
        shearing resistance of sand and the approximate inclination of
        the failure plane to the horizontal. Represent the parameters by
        means of Mohr Circle.

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UNIT-I

1. a) What is the use of the classification of soils? Discuss the Indianstandard classificationsystem. [7M]
    b) Explain in detailthe texture and structure of soils. [7M]

(OR)

2. a) What are the different soil indices used in the identification of soil? Describe eachone. Give their uses. [7M]
    b) Explain the transported soils and soil formation. [7M]

UNIT-II

3. a) What are the different techniques available to determine the grain size distribution of soil samples? Explain any two methods with neat sketches. [9M]
    b) A soil has a bulk unit weight of 20 KN/m^3 at a water content of 16%. Calculate the porosity, degree of saturation, and air content, if the specific gravity is 2.65. [5M]

(OR)

4. a) The porosity of the soil sample is 35% and the specific Gravity of its particles is 2.7. Calculate its void ratio, Dry Unit weight, Saturated Unit Weight, and Submerged Unit weight. [6M]
    b) Derive the expression for Darcy's law. State the assumptions made in Darcy's law and what are their practical reliability. [8M]

UNIT-III

5. a) A load of 1000 kN acts as a point load at the surface of a soil mass. Estimate the stress at a point 3m below and 4m away from the point of action of the load by Boussinesq's formula. Compare the value with the result from Westergaard's theory. [8M]
    b) Compare and contrast Boussinesq's and Westergaard's theories. [6M]

(OR)

6. a) Briefly explain the construction of Newmark's Influence Chart along with its usage. [6M]
    b) A uniform homogeneous sand deposit of specific gravity 2.60 and void ratio 0.65extends to a large depth. The ground water table is 2 m from Ground Level Determine theeffective, neutral, and total stress at depths of 2 m and 6 m. Assume that the soil from1 m to 2 m has capillary moisture leading to the degree of saturation of 60%. [8M]

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UNIT-IV

7. a) Define the following terms [6M]

    (i) Over Consolidated Soil (ii) Normally Consolidated soils (iii) Under Consolidated soils

    b) A fully saturated clay specimen is placed in a consolidometer and 2 kg/cm² pressure is applied, after some time the pore pressure is found to be 0.70 kg/cm² and the change in thickness of the sample is found to be 1mm. Find the final settlement that will occur under the applied load. [8M]

(OR)

8. a) A cohesive soil yielded a maximum dry density of 1.8 g/cc at an OMC of 16% during a standard Proctor test with a specific gravity of 2.65. What is its void ratio, degree of saturation, Air content, and percentages of air voids in the soil? What is the maximum density it can Be further compacted to? [9M]

    b) How do you determine the consolidated settlement of a foundation? [5M]

UNIT-V

9. a) In a drained triaxial compression test, a saturated specimen of cohesionless sand fails under deviator stress of 5.35 kg/cm². When the cell pressure is 1.5 kg/cm², find the effective angle of shearing resistance of sand and the approximate inclination of the failure plane to the horizontal. Represent the parameters by means of Mohr Circle. [10 M]

    b) Define Dilatancy of Soil and Critical Void Ratio with suitable equations. [4M]

(OR)

10. a) What is the shear strength in terms of effective stress on a plane within a saturated soil mass at a point where the total normal stress is 295 kPa and the pore water pressure 120 kPa. The effective shear strength parameters of the soil are C'=12 kPa and φ=30°. [8M]

    b) Explain the stress-strain behavior of clays. [6M]

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UNIT-I

1. a) Describe the formation of soil due to mechanical weathering with neat sketches. [6M]
   b) Explain the Unified Classification of Soils with neat sketches, wherever necessary. [8M]

(OR)

2. a) Explain the procedure of hydrometer analysis with neat sketches. [7M]
   b) Explain the Indian Standard (IS) Classification of Soils with neat sketches, wherever necessary. [7M]

UNIT-II

3. a) Derive an expression to determine the coefficient of permeability of soil by laboratoryfalling head permeability test. [9M]
   b) What are the limitations of the hydrometer test? [5M]

(OR)

4. a) What is a flow net? What are its properties and applications? [7M]
   b) A soil has a liquid limit of 25% and a flow index of 12.5%, if the plastic limit of soil is 15%. Determine the plasticity index andtoughness index. If the water content of the soil in its natural condition in the field is 20%, find the liquidity index and relative consistency. [7M]

UNIT-III

5. a) Briefly explain the construction of Newmark's Influence Chart along with its usage. [6M]
   b) A soil profile consists of a surface layer of sand 4m thick (γ=1600 kg/m^3) an intermediate layer of clay 3.5m thick (γ=1900 kg/m^3) and a bottom layer of gravel 4m thick (γ=1925 kg/m^3). The water table is at the upper surface of the clay layer. Compute the effective stress at various levels due to the placement of a surcharge of 5000 kg/m^2 on the ground surface. [8M]

(OR)

6. a) Explain how the vertical pressure isdetermined due to strip load. [7M]
   b) A ring foundation is of 3.0 m external diameter and 2.0 m internal diameter. Ittransmits a uniform pressure of 90.0 kN/m^2. Calculate the vertical stress at adepth of 1.50 m directly beneath the center of the loaded area. [7M]

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UNIT-IV

7. a) What is compaction and how it is different from consolidation? [5M]
   b) An oedometer test is performed on a 4 cm thick clay sample. [9M] After 5 minutes, 50% consolidation is reached. After how long a time would the same degree ofconsolidation is achieved in the field where the clay layer is 8 m thick? Assumethe sample and the clay layer has the same drainage boundary conditions (double drainage).

(OR)

8. a) What are the assumptions made in Terzaghi's one dimensional [6M] consolidation theory?
   b) A soil is to be excavated from a borrow pit which has a density of [8M] 1.75 g/cc and water content of 12%. The specific gravity of solid particles is 2.7. The soil is to be compacted to a water content of 18% and dry density of 1.65 g/cc. For 1000 m3 of soil in fill estimate
   (i) Quantity of soil to be excavated from the pit in m3
   (ii) Amount of water to be added to increase the water content from 12% to 18%

UNIT-V

9. a) Explain the detailed procedure of the laboratory triaxial shear [7M] test.
   b) In an unconfined compression test, a sample of sandy clay 8cm [7M] long and 4cm in diameter fails under a load of 120N at 10% strain. Compute the shearing resistance taking into account the effect of change in the cross-section of the sample.

(OR)

10. a) Explain different drainage conditions adopted in shear tests with [6M] their suitability.
    b) In a direct shear test on a specimen of clean dry sand, normal [8M] stress of 180kPawas applied and failure occurred at a shear stress of 100kPa. Determineanalytically the angle of shearing resistance, the principal stresses during failure,and directions of the principal planes with respect to the direction of the plane ofshearing.

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UNIT-I

1. a) Explain the terms adsorbed water and relative density along with their relationship if any. [5M]

    b) The following results were recorded in a shrinkage limit test using mercury [9M]
    Mass of container =17.0g
    Mass of wet soil and container =72.30g
    Mass of dish =132.40g
    Mass of dish and displaced mercury =486.10g
    Mass of dry soil and container =58.20g
    Volume of wet soil =32.4 cm^3
    Determine the shrinkage limit, the linear shrinkage and the shrinkage ratio. Thedensity of mercury is 13.6g/cm^3.

(OR)

2. a) What do you mean by Weathering? Explain how soils are formed by the weathering process. [7M]

    b) Explain the transported soils and soil formation. [7M]

UNIT-II

3. a) What do you mean by Capillary rise and Capillary depression? Where will you find them? Derive an expression for the capillary rise with the help of a neat sketch. [9M]

    b) Write a short note on the corrections to be applied to hydrometer test readings. [5M]

(OR)

4. a) Explain permeability also describe various factors effecting the permeability. [6M]

    b) In a hydrometer test, the initial reading is 1.08. After one hour, the correctedhydrometer reading is 1.03 and the corresponding effective depth is 12cm. Findthe initial weight of soil placed in 1000cc suspension, the particle sizecorresponding to the 15min reading, and the percentage of particles finer than thissize. Take G =2.65, and μ=0.1 poise. [8M]

UNIT-III

5. a) Explain the determination of vertical pressuredue to stripload. [7M]

    b) A strip load of considerable length and 1.50 m width transmits a pressure of 150kN/m^2 to the underlying soil. Determine the maximum principal stress at 0.75 mdepth below the footing, if the point lies (i) directly below the center of the footing,and (ii) directly below the edge of the footing [7M]

(OR)

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6. a) Derive an expression of vertical stress for normal load aver a circular area. [7M]

b) The four legs of a transmission tower form in plan a square of side 4m and togethercarry a total load of 200kN. Compute the increase in vertical stress at a depth of 3mvertically below a Leg. Use Boussinesq's theory. [7M]

UNIT-IV

7. a) Explain concept of consolidation using Spring Analogy. [6M]

b) An oedometer test is performed on a 2 cm thick clay sample. After 5 minutes, 50% consolidation is reached. After how long time would the same degree of consolidation is achieved in the field where the clay layer is 3.70 m thick? Assume the sample and the clay layers have the same drainage boundary conditions (double drainage). [8M]

(OR)

8. a) Define the following terms [6M]
(i) Over Consolidated Soil (ii) Normally Consolidated soils (iii) Under Consolidated soils

b) A cohesive soil yielded a maximum dry density of 1.8 g/cc at an OMC of 16% during a standard Proctor test with a specific gravity of 2.65. What is its void ratio, degree of saturation, Air content and percentages of air voids in the soil? What is the maximum density it can Be further compacted to? [8M]

UNIT-V

9. a) Explain in detail about the laboratory box shear test. [7M]

b) The following results were obtained from a direct shear test on a sandy claysample. [7M]

Normal load (N)	Shear load proving ring reading (divisions)
360	13
720	19
1080	26
1440	26

If the shear box is 60mm square and the proving ring constant is 20N per division,estimate the shear strength parameters of the soil. Would failure occur on a planewithin this soil at a point where the normal stress is 320kN/m^2 and thecorresponding shear stress is 138kN/m^2?

(OR)

10. a) Explain the shear characteristics of sand? [6M]

b) The following results were obtained from a triaxial test on two soil specimens. [8M]

Sample No.	Confining Pressure(kPa)	Deviator Stress at failure(kPa)	Pore water pressure(kPa)
1	200	244	55
2	300	314	107

Determine the shear strength parameters of the soil terms of
(i) total stresses ii) effective stresses.

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