C Reg. No. : | | | | | | | | | | | | |

**Question Paper Code: R4102**

B.E. / B.Tech. DEGREE EXAMINATION, APRIL / MAY 2025

Fourth Semester

Civil Engineering

R21UCE402- SOIL MECHANICS

(Regulations R2021)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (5 x 1 = 5 Marks)

1. Which Water content determination method is not suitable for organic soil…… CO1- U

   (a) Sand bath method (b) Oven drying method

   (c) Alcohol method (d) Calcium carbide method

2. Permeability is higher in _____ CO1- U

   (a) Parallel to the strata (b) Perpendicular to the strata

   (c) Both of (a) & (b) (d) None of above

3. With an increase in the amount of compaction energy ……. CO1- U

   (a) Optimum water content increases but maximum dry density decreases

   (b) Optimum water content decreases but maximum dry density increases

   (c) Both optimum water content and maximum dry density increase

   (d) Both optimum water content and maximum dry density decrease

4. In a consolidated drained test on a normal consolidated clay, the volume of the soil sample during shear CO1- U

   (a) decreases (b) increases

   (c) remains unchanged (d) first increases and then decreases

5. The factor of safety of an infinite slope in a sand deposit is 1.732. If the angle of shearing resistance is $30^0$, the safe slope is CO2- App

   (a) $19.45^0$ (b) $75.4^0$ (c) $18.4^0$ (d) $71.6^0$

PART – B (5 x 3= 15 Marks)

| | | |
|---|---|---|
| 6. | Draw the Three Phase diagram. | CO1-U |
| 7. | Determine the value of critical hydraulic gradient for a loose sand deposit having void ratio of 0.67 and specific gravity of 2.67. | CO3-App |
| 8. | Give the formula for Zero air voids line | CO1-U |
| 9. | The laboratory results obtained from direct shear test. The normal stress at failure is 200 kPa and shear stress is 50 kPa. Calculate the angle of internal friction of the soil. | CO2 App |
| 10. | List out the types of failure occurs in finite and infinite slope | CO1-U |

PART – C (5 x 16= 80 Marks)

| | | | | |
|---|---|---|---|---|
| 11. | (a) | The mass specific gravity of a fully saturated specimen of clay having a water content of 40% is 1.88. on oven drying the mass specific gravity drops to 1.74.calculate the specific gravity of clay and its shrinkage limit. | CO2- App | (16) |
| | | Or | | |
| | (b) | A soil sample has a porosity of 20% the specific gravity of solids is 2.70.Calculate a) Void ratio b) dry density c) Unit weight if the soil is 30% saturated and d) unit weight if the soil is completely saturated | CO2- App | (16) |
| 12. | (a) | In a falling head permeability test the length and area of cross section of soil specimen are 0.17 m and 21.8 x $10^{-4}$ $m^2$ respectively. Calculate the time required for the head to drop from 0.25 m to 0.10 m. The area of cross section of stand pipe is 2.0 x 10-4 m2 . The sample has three layers with permeabilities 3 x 10-5 m/sec for first 0.06 m, 4 x 10-5 m/sec for second 0.06 m and 6 x 10-5 m/sec for the third 0.05 m thickness. Assume the flow is taking place perpendicular to the bedding plane. | CO4- Ana | (16) |
| | | Or | | |
| | (b) | Analyse advantages of Boussinesq's solution over the Westergaard's solution for vertical stress distribution. | CO4-Ana | (16) |
| 13. | (a) | A Cohesive Yields a Maximum dry density of 1.8 g/cc at an OMC of 16% during a standard proctor test Specific gravity values of 2.65.What is the degree of saturation? What is the maximum dry density it can further Compaction? | CO4- Ana | (16) |

Or

(b) A Laboratory Compaction test on soil having specific gravity = 2.68 gave a maximum dry density of 1.82 g/cm$^3$ and a water content of 17% determine the degree of saturation, air content and Percentage of air voids and at the max dry density. What would be theoretical max density corresponding to zero air voids at the optimum water content. CO4- Ana (16)

14. (a) Direct Shear Test was conducted on Compacted Sand Shear Box Dimensions 60mm x 60 mm. The readings are listed below. CO4- Ana (16)

| Normal load (N) | 110 | 225 | 30 |
|---|---|---|---|
| Peak shear load (N) | 95 | 195 | 294 |
| Ultimate shear load (N) | 65 | 135 | 100 |

Examine the angle of shearing resistance in

a. Dense compacted state

b. Loose state

Or

(b) An unconfined compression test was conducted on an undisturbed sample of clay .the sample had a diameter of 38 mm and length 76 mm. The load at failure was 30 N and the axial deformation of the sample 11mm. Estimate the undrained shear strength parameters , if the failure plane made an angle of 50$^o$with horizontal. CO4- Ana (16)

15. (a) Explain in detail about the friction circle method of stability Analysis with neat sketch. CO1- U (16)

Or

(b) Explain the slope protection measures in practice with neat sketch CO1- U (16)

**R4102**