Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. / B. Tech. / B. Arch. (Full Time) - END SEMESTER EXAMINATIONS, APR / MAY 2024

CIVIL ENGINEERING
Semester IV
CE5405 SOIL MECHANICS
(Regulation 2019)

Time: 3hrs

Max. Marks: 100

CO1	Graduates will demonstrate an ability to identify various types of soils and its properties, formulate and solve engineering Problems
CO2	Graduate will show the basic understanding of flow through soil medium and its impact of engineering solution
CO3	Graduate to understand about the basic concept of stress distribution in loaded soil medium and soil settlement due to consolidation
CO4	Graduate will show the understanding of shear strength of soils and its impact of engineering solutions to the loaded soil medium and will be aware of contemporary issues on shear strength of soils.
CO5	Graduates will demonstrate an ability to design both finite and infinite slopes, component, and process as per needs and specifications.

BL – Bloom's Taxonomy Levels
(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

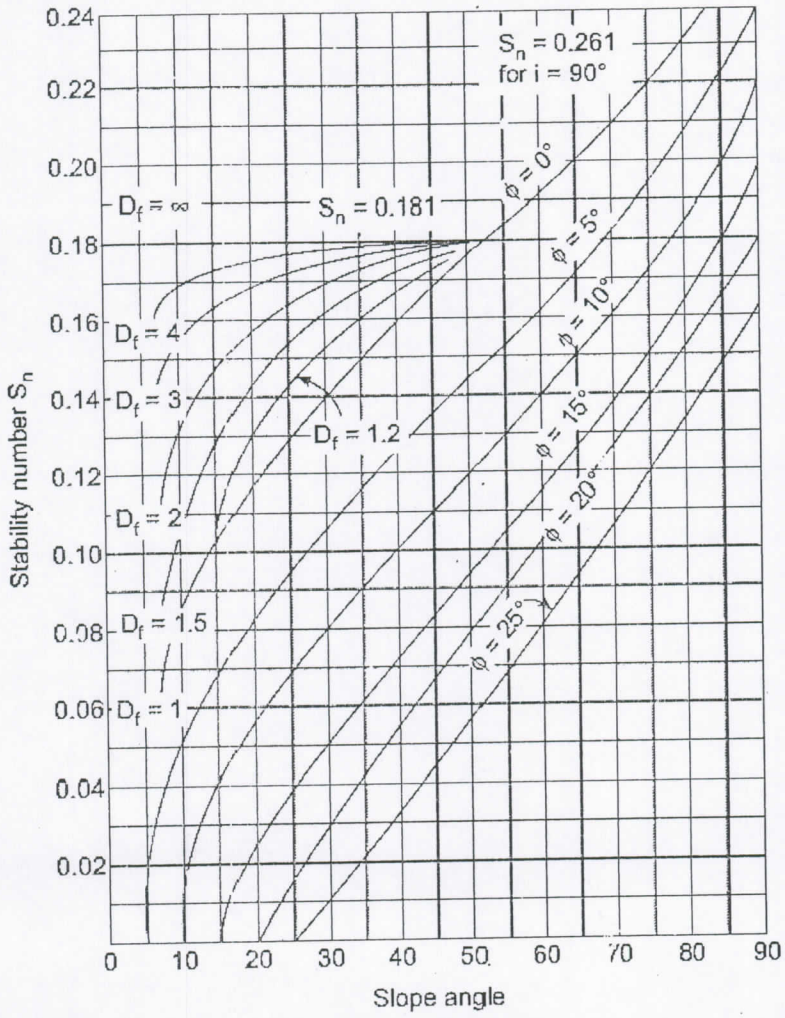
PART- A (10x2=20Marks)

Q. No.	Questions	Marks	CO	BL
1	State two reasons for complex behaviour of soils.	2	1	1
2	What is the influence of compactive effort on the compaction characteristics?	2	1	2
3	What is structural water?	2	2	1
4	What do you understand from the term 'critical hydraulic gradient'?	2	2	2
5	What is a pressure bulb?	2	3	1
6	How is t_{90} determined from Taylor's method?	2	3	2
7	What are the different modes of failure in an unconfined compression strength test?	2	4	1
8	What is a pore pressure parameter?	2	4	1
9	What is base failure and when does it occur?	2	5	2
10	List two reasons for failure of slopes.	2	5	1

PART- B (5x 13=65Marks)

Q. No.	Questions	Marks	CO	BL
11 (a)	A 1000cc core cutter weighing 9.46 N was used to find the in-situ unit weight of the soil in an embankment. The weight of the core cutter with in-situ soil was noted to be 27.7 N. Laboratory tests on the sample indicated a water content of 10% and specific gravity of solids of 2.63. Determine the bulk unit weight, dry unit weight, voids ratio and degree of saturation. If the embankment gets saturated due to rain, determine the unit weight after rain and the corresponding water content without volume change. If there is a 10% increase in volume due to swelling, determine the quantity of water required to saturate the soil.	13	1	3
	OR			
11 (b)	Characterize the soil by performing a grain size analysis on 500g of soil based on the following data. What is the effective diameter of the grains of this soil sample?	13	1	3

	Sieve size, mm	4.75	2.36	1.18	600μ	300μ	150μ	75μ			
	Wt. retained, g	-	72	91	75	182	15	55			
12 (a)	A soil profile data is tabulated below. The water table is at a depth of 4m below the ground level. Draw the distribution of total, neutral and effective stress for the profile with depth. Layer / Thickness (m) / Properties: Fine Sand / 3 / n = 0.4 ; G_s = 2.65 ; S = 30% Silt / 3 / S = 80% ; e = 0.6 ; G_s = 2.68 Peat / 3 / e = 3 ; G_s = 2.1 Silty clay / 4 / w_{sat} = 35% ; G_s = 2.6								**13**	2	3
	OR										
12 (b) (i)	In a constant head permeameter test, the following observations were taken. Distance between piezometer tappings = 15 cm, difference of water levels in piezometers = 40 cm, diameter of the test sample = 5 cm, quantity of water collected = 500 ml, duration of the test = 900 sec. Determine the coefficient of permeability of the soil. If the dry mass of the 15 cm long sample is 486 g and specific gravity of the solids is 2.65. Calculate seepage velocity of water during the test.								**8**	2	3
12 (b) (ii)	A clay deposit of thickness 6m (approx.) is having a series of silt separations at an average vertical spacing of 2m. The thickness of the interspersing silt layers is 4.5 mm. Determine the ratio of horizontal to vertical permeability of clay if the permeability of silt is 75 times that of clay.								**5**	2	3
13 (a)	A homogeneous clay layer 12m thick is expected to have an ultimate settlement of 332mm. After a time span of 3 years, the average settlement was measured to be 152 mm. How much longer will it take for the average settlement to attain 237 mm? How much settlement will occur after 10 years?								**13**	3	4
	OR										
13 (b)	The base of a tower consists of an equilateral triangular frame, on the corners of which the three legs of the tower is supported. The total weight of the tower is 600kN, equally distributed to all the legs. Compute the increase in vertical stress at a point 5m below (i) one of the legs (ii) the midway point between any two legs (iii) the centre of the tower base.								**13**	3	4
14 (a)	Two identical soil specimens were tested in a triaxial apparatus. First specimen failed at a deviator stress of 440 kPa when cell pressure was 90 kPa. The second specimen failed at a deviator stress of 610 kPa under a cell pressure of 182 kPa. Determine the values of the shear strength parameters.								**13**	4	3
	OR										
14 (b)	The following are the results of a shear box test on a soil; Normal Stress, kPa 25 75 150 250 Shear Stress, kPa 60 80 105 145 Determine the shear strength parameters.								**13**	4	3
15 (a) (i)	A long natural slope in a c-φ soil is inclined at an angle of 12° to the horizontal. Determine the factor of safety if the slip plane develops at a depth of 4m. If due to rains, the water table rises to the ground level, what is the new factor of safety? If there is seepage parallel to the slope, determine the factor of safety. Take c = 8 kN/m^2; φ = 22°; and γ_{sat} = 19kN/m^3.								**7**	5	4
15 (a) (ii)	A new canal is to be excavated to a depth of 4.5m below the ground level, through a soil having the following characteristics. c								**6**	5	4

	= 18 kPa; φ = 16°; e = 0.85; G_s = 2.72. The slope of the bank is 1.5:1. With the help of Taylor's chart provided (Fig. 1), analyse the safety of the side slope of the canal when the canal runs full. If the canal is suddenly emptied, what will be safety factor?  Figure 1 Taylor's Chart			
	OR			
15 (b)	Analyse the stability of a slope in a purely cohesive soil with φ_u = 0; c_u = 30 kPa and γ = 20.5 kN/m³. The height of the slope is 6.5m. The radius of the slip circle is 13.5m. The slip circle starts at 3m from the crest of the slope. The centre of gravity of the failure wedge lies at a horizontal distance of 6m from the centre of rotation of the slip circle. The horizontal projection of the slope is 12m.	**13**	5	4

PART- C (1x 15=15Marks)

Q. No.	Questions	Marks	CO	BL
16.	A saturated soil has a compression index of 0.25. Its void ratio at a stress of 10 kN/m² is 2.02 and its permeability is 3.4 x 10^{-7} mm/s. Evaluate the change in voids ratio if the stress is increased from 10 to 19 kN/m². What will be the settlement if the soil layer is 5m thick? How long will it take to achieve 40% consolidation with single and double drainage?	**15**	3	5