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

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E.(Full Time) - END SEMESTER ARREAR EXAMINATIONS, NOV / DEC 2024

CIVIL ENGINEERING
Fourth Semester
CE5405 &Soil Mechanics
(Regulation2019)

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 also 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)
(Answer all Questions)

Q.No.	Questions	Marks	CO	BL
1	Explain reasons for mostly using void ratio in soil engineering rather than the porosity.	2	1	2
2	List any two field compaction method along with its soil suitability.	2	1	1
3	Examine the following statement is true or false and justify your answer, 'Darcy's law is valid for flow through gravelly soils'	2	2	4
4	Identify various properties of flownet and its use in soil engineering	2	2	3
5	Compare Boussinesq's stress distribution theory with Westergaard's theory.	2	3	2
6	Define over consolidation ratio and its significance.	2	3	1
7	Write the Coulomb's shear strength equation? and illustrate various components of it.	2	4	1
8	Classify different types of shear test based on drainage conditions.	2	4	2
9	Explain the effect of water table on the factor of safety of infinite slope.	2	5	4
10	List various factors that affecting the factor of safety of an infinite slope in sand and clay.	2	5	1

PART- B(5x 13=65Marks)
(Restrict to a maximum of 2 subdivisions)

Q.No.	Questions	Marks	CO	BL
11a. (i)	Draw typical grain size distribution curves for: (a) A well graded soil (b) A poorly graded soil (c) A gap graded soil. Among the above three types of soil, which soil would you consider as the best foundation soil?	7	1	2

(ii)	A sample of soil with a liquid limit of 73 % is found to have a liquidity index of 1.21 and water content of 81%. Solve for finding its plastic limit and plasticity index and comment on the consistency of the soil.	6	1	3
	OR			
11b. (i)	Explain about various factors that influencing on compaction characteristics of soil.	7	1	2
(ii)	During a Proctor's compaction test, the weight of soil was measured 1.905 kg at moisture content of 17.54%. The proctor mould was measured to be 104 mm in diameter and 112 mm in height. Solve for finding the dry density, void ratio and degree of saturation of the soil.	6	1	3
12a. (i)	List various types of permeability tests are to be conducted in field and discuss any one method in details.	7	2	2
(ii)	A constant head permeability test was carried out on a cylindrical soil sample of sand having a diameter of 0.10 m and 0.15 m height. 0.00016 $m^3$of water was collected in 1.75 min. under a head of 0.30 m. Compute the coefficient of permeability in m/year and the discharge velocity of flow..	6	2	3
	OR			
12b. (i)	Derive an expression for finding the quantity of seepage flow across a hydraulic structure from the flownet with listing all assumptions involved.	7	2	2
(ii)	The foundation soil at the toe of a dam has a void ratio of 0.72 and specific gravity of 2.65. To ensure safety against piping, the upward gradient must not exceed 30 % of the critical gradient at which quicksand conditions occur. Estimate the maximum permissible upward gradient.	6	2	3
13a. (i)	Explain in details of the Newmark's influence chart and its use in soil engineering.	7	3	2
(ii)	A concentrated load 10kN 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.	6	3	1
	OR			
13b. (i)	Explain in details of various factors that influencing on the cmpressibility characteristics of soil with illustrative figures.	7	3	2
(ii)	In a consolidation test on a soil, the void ratio of the sample decrease from 1.24 to 1.12 when the pressure is increased from 200 to 400 kN/m^2. Estimate the coefficient of consolidation in m^2/year given that the permeability of the soil during this pressure increment is 8.5×10^{-9} m/sec.	6	3	1
14a. (i)	Explain about various advantages and disadvantages of direct shear test over triaxial shear test?	6	4	5
(ii)	A vane of 80 mm in diameter and 160 mm in height has been pushed into an in situ soft clay at the bottom of a bore hole. The torque required to rotate the vane is 76 N-m. Determine the undrained shear strength of the clay. After the test, the vane was rotated several times and the ultimate torque was found to be 50 N-m. Estimate the sensitivity of the clay.	7	4	4
	OR			
14b. (i)	Prove that the unit cohesion obtained from the UCC test on a saturated clay soil is half of its unconfined compressive strength.	6	4	5
(ii)	A CU test was conducted on soil specimens of sandy clay with the			

	following results were obtained; Specimen No. | 1 | 2 | 3 σ_1 kN/m^2 | 180 | 210 | 270 σ_3 kN/m^2 | 30 | 60 | 90 u kN/m^2 | 20 | 35 | 48 Determine the shear strength parameters by considering (a) the total stress and (b) the effective stress conditions.	7	4	4
15a. (i)	Describe the common modes of failure of infinite and finite slopes with neat sketches.	6	5	5
(ii)	Find the factor of safety of a slope of infinite extent having a slope angle = 25°. The slope is made of clay having c' = 30 kN/m^2, ϕ' = 20°, γ_b=17.24kN/m^3 and γ_{sat}=19.14kN/m^3 under the following conditions: (i) when the soil is dry, (ii) when water seeps parallel to the surface of the slope, and (iii) when the slope is submerged.	7	5	3
	OR			
15b. (i)	What is meant stability number? and explain about the procedure that is to be followed for computing the factor of safety of slope using the stability number.	6	5	5
(ii)	An embankment is to be made from a soil with c_u = 20 kN/m^2, ϕ_u = 20° and γ = 20 kN/m^3. If a factor of safety of 1.5 with respect to shear strength is required for the embankment slope, determine (i) the limiting height of the slope if built at a slope angle of 25° and (ii) angle of the slope if the embankment height is to be kept at 18 m.	7	5	3

PART- C(1 × 15 = 15 Marks)

(Q.No.16 is compulsory)

Q.No.	Questions	Marks	CO	BL
16. (i)	Earthen embankment is to be constructed with soils compacted to a γ_{dry} of 18.5 kN/m^3 and moisture content of 17 %. The soils to be excavated from the borrow pit for construction of an embankment is having a γ_{bulk} of 17.5 kN/m^3 and natural moisture content of 10%. How much excavation should be carried out in the borrow pit for construction of each 1 m^3 of an embankment.	7	1	6
(ii)	It is proposed to place the footing on a clay layer of 8 m thickness has a bulk unit weight of 20 kN/m^3 and specific gravity of 2.72. The liquid limit of the clay is 58 %. The footing constructed on the clay is to support the structure that produces an incremental pressure by a 10 % of the overburden pressure. Estimate the consolidation settlement of the footing.	8	3	6
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