Ref. No. Ex/CE/PC/B/T/223/2022

BACHELOR OF ENGINEERING (CIVIL ENGINEERING) EXAMINATION 2022

[Second Year; Second Semester]

Geotechnical Engineering - I

Total Time: Three Hours

Full Marks 100
(Part I: 40 + Part II: 30 + Part III: 30)

Use a separate Answer-Script for each part

Part I (40 Marks)

Attempt All Questions (4 × 10 = 40)

1	(a)	Define liquid limit, plastic limit, and shrinkage limit of soil. How important are these values in connection to civil engineering activities?	(3)
	(b)	Write the importance of 'A-Line'. Define 'Sand Boiling' through required numerical expressions.	(4)
	(c)	Define permeability and seepage. Establish the relation between seepage velocity and discharge velocity.	(3)
2	(a)	What is 'Diffuse Double Layer'? How important is this in Geotechnical Engineering?	(4)
	(b)	What is 'Drilling Mud"? Write its applicability in Geotechnical Engineering.	(3)
	(c)	Define flocculated and dispersed structure in connection with clay mineralogy.	(3)
3	(a)	Derive the expression for equivalent coefficient of permeability when the water is flowing perpendicularly to the bedding plane having n-numbers of soil layers of different thicknesses. The coefficient of permeability of the individual layers is different.	(4)
	(b)	What is a flow net? Answer with a net sketch.	(2)
	(c)	Compute the effective stress at a depth of 6 m below the ground if capillary rise above the water table is 1 m for a deposit of sand with a porosity of 40% and specific gravity of particles is 2.7. In this case, the groundwater table is located 2 m below the ground surface.	(4)
4	(a)	Deduce, in detail, the expression required to determine the height of 'capillary rise'.	(3)
	(b)	Write the two important design philosophies while selecting the 'filter material' with necessary expressions as proposed by Terzaghi and Peck (1948).	(3)
	(c)	What is backward piping? How can it be prevented?	(4)

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Geotechnical Engg-I

[PART-II]

Full Marks 100
(30 marks for this part)

Question No.	(Answer all the questions.) [Assume any data reasonably if necessary]	Marks
1. (a)	Discuss in brief about the factors that affect field compaction.	
(b)	The maximum and minimum dry densities of sand were determined in the laboratory to be 1682 kg/m^3 and 1510 kg/m^3, respectively. In the field, if the relative density of compaction of the same sand is 70%, what are its relative compaction (%) and dry density (kg/m^3)?	[3+5]
[CO3]		
2. (a)	Derive the differential equation of Terzaghi's 1D consolidation theory.	
(b)	Discuss about the non-dimensional parameters by which the solution of the above equation is represented.	[10+3]
[CO3]		
3. (a)	Discuss on different phases of sub-soil exploration.	
(b)	What is SPT 'N' value? Discuss about the IS code suggested corrections of SPT 'N' value.	[5 +4]
[CO6]		

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B. E. CIVIL ENGINEERING SECOND YEAR SECOND SEMESTER – 2022

GEOTECHNICAL ENGINEERING - I

TIME: Three Hours **FULL MARKS: 100**

(Part I: 40 + Part II: 30 + Part III: 30)

Part III (30 Marks)

Use Separate Answer scripts for each Part

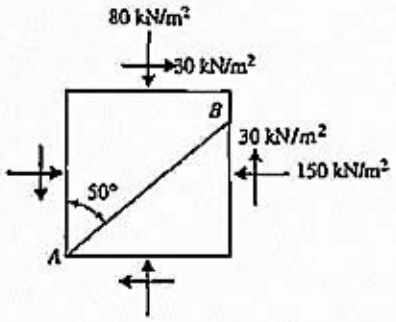
Attempt All Questions [3×10=30]

1. (a) Show the difference in changes in pore water pressure between NC clay and OC clay during a CU test. [1]

   (b) Write the disadvantages of the direct shear test. [2]

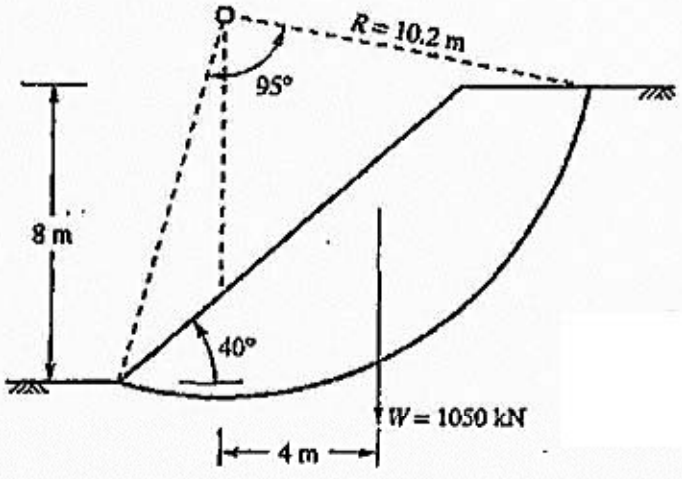
   (c) A consolidated undrained test on a normally consolidated clay yielded the following results:
   Cell pressure: 44 kPa
   Deviatoric stress: 160 kPa
   Pore pressure: 20 kPa
   Calculate the consolidated-undrained and consolidated-drained shear strength parameters. [3]

   (d) For the soil element as shown below draw the Mohr-Circle corresponding to the given state of stresses. Then, find the maximum and minimum principal stresses and their directions. Also, determine the normal and shear stresses on plane AB. [4]



2. (a) What are the different modes of failure in the case of a finite slope? [1]

   (b) A finite slope is excavated to a depth of 8 m in a deep layer of saturated clay having c = 60 kN/m² and γ= 19 kN/m³. Determine the factor of safety for the circular trial failure surface as shown in the figure. [2]



(c) Derive the expression of stability number for a fully submerged cohesive-frictional infinite slope. [3]

(d) An infinite slope in sandy soil is inclined at 20° to the horizontal. The properties of the soil are, $\phi = 34°$, $\gamma = 17$ kN/m^3, and $\gamma_{sat} = 21$ kN/m^3. A hard layer exists 5 m below and parallel to the surface. Calculate the factor of safety of the slope when: (i) the soil is dry, (ii) the slope is completely submerged with seepage parallel to the surface, and (iii) the water table level is parallel to the ground and surface at 2.5 m depth, seepage being parallel. [4]

3. (a) Plot the relationship between wall movement and lateral earth pressure, and then mark the points corresponding to 'earth pressure at rest', 'active earth pressure', and 'passive earth pressure'. [1]

(b) Write the differences between Rankine's and Coulomb's earth pressure theory. [2]

(c) Derive the expression for Rankine's passive pressure against the vertical retaining wall at a depth z from the horizontal ground surface. The unit weight of soil is γ. Cohesion and friction angle of backfill soil are c and ϕ respectively. [3]

(d) A smooth retaining wall is 4 m high and supports a cohesive-frictional backfill with a unit weight of 17 kN/m^3. The shear strength parameters are, cohesion = 10 kPa and friction angle = 10°. Calculate: (i) the depth at which total lateral pressure is zero and (ii) the total active thrust against the wall and the point of action of the resultant thrust. Assume that the tension crack has developed to the full theoretical depth. [4]