

BACHELOR OF ENGINEERING (CIVIL ENGINEERING) EXAMINATION 2025

[Third Year; First Semester]

SOIL MECHANICS – I

Total Time: Three Hours

PART I (60 Marks)

Full Marks: 100 (60+40)

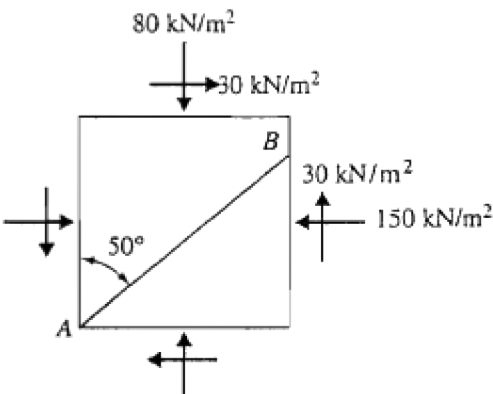
*Answer all the questions**Answer should be brief and to the point.**Assume any data reasonably if needed*

1.	(a)	What is the difference between specific gravity of soil mass and specific gravity of soil solids.	(2)																
	(b)	Derive the relationship between relative density and porosity.	(3)																
	(c)	The following data were obtained in the laboratory for Soil A : <table><tr><th colspan="2">Soil A</th></tr><tr><th>No. of blows</th><th>Water Content (%)</th></tr><tr><td>8</td><td>43</td></tr><tr><td>20</td><td>39</td></tr><tr><td>30</td><td>37</td></tr><tr><td>45</td><td>35</td></tr><tr><td colspan="2">PL=25%</td></tr><tr><td colspan="2">Natural water content =40%</td></tr></table> Determine the liquid limit and flow index for the soil by graphical method. Also determine plasticity index, liquidity index, and toughness index.	Soil A		No. of blows	Water Content (%)	8	43	20	39	30	37	45	35	PL=25%		Natural water content =40%		(10)
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2.	(a)	Express the capillary rise in a tube in terms of surface tension and inner diameter of the tube. Prove the relationship.	(5)						
	(b)	<table><tr><td>Length of specimen = 200 mm</td><td>At time $t = 0$, the head difference is 500 mm</td></tr><tr><td>Area of standpipe = 40 mm²</td><td>At time $t = 180$ sec, the head difference is</td></tr><tr><td>Area of soil specimen = 1000 mm²</td><td>300 mm</td></tr></table> For a falling-head permeability test, Determine the hydraulic conductivity of the soil in cm/sec. based on the above values.	Length of specimen = 200 mm	At time $t = 0$, the head difference is 500 mm	Area of standpipe = 40 mm ²	At time $t = 180$ sec, the head difference is	Area of soil specimen = 1000 mm ²	300 mm	(5)
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Area of soil specimen = 1000 mm ²	300 mm								
	(c)	What is critical hydraulic gradient? Derive a relationship between the critical hydraulic gradient and porosity.	(5)						

[Turn over

3.	(a)	Derive the basic equation for two dimensional flow.	(5)
	(b)	What are the salient characteristics of a flow net? What are its uses ?	(5)
	(c)	For a homogeneous earth dam 52 m high and 2 m freeboard, a flow net was constructed and following results were obtained: Number of potential drops= 20 Number of flow channels = 5 Calculate the discharge per metre length of the dam, if the coefficient of permeability of the dam material is 3×10^{-5} m/sec. Also estimate the exit gradient if the average length of the last flow field is 0.9 m.	(5)

4.	(a)	Draw the Mohr-Circle and explain the procedure of obtaining shear strength parameters from UCS test.	(5)
	(b)	 Determine the normal and shear stress on the plane AB by method of pole.	(10)

B. E. (CIVIL ENGINEERING) THIRD YEAR FIRST SEMESTER EXAM 2025**SOIL MECHANICS -I
PART-II**

Time: Three Hours

Full Marks 100
(40 marks for Part II)

Use a separate Answer-Script for each part

No. of questions		Marks (40)														
1)	The following data were recorded while performing the compaction test: <table><tr><td>Water content (%)</td><td>8.6</td><td>12.1</td><td>13.7</td><td>15.6</td><td>18.1</td><td>20.3</td></tr><tr><td>Weight of wet sample (kg)</td><td>1.82</td><td>1.93</td><td>2.02</td><td>2.06</td><td>2.01</td><td>1.96</td></tr></table> Plot the compaction curve and find the optimum water content and maximum dry density. Provided $G = 2.68$, find air void percentage at maximum dry density. Also plot 80 % and 100 % saturation lines.	Water content (%)	8.6	12.1	13.7	15.6	18.1	20.3	Weight of wet sample (kg)	1.82	1.93	2.02	2.06	2.01	1.96	8
Water content (%)	8.6	12.1	13.7	15.6	18.1	20.3										
Weight of wet sample (kg)	1.82	1.93	2.02	2.06	2.01	1.96										
2)	The in situ water content of a borrow pit is 15 %, void ratio = 0.60 and specific gravity of the soil is 2.68. The soil is to be excavated and transported to construction site, then compacted to minimum dry density of 17.6 kN/m^3 at moisture content 18 %. Soil is excavated and transported through trucks of capacity 5 Cu.M. (a) How many cubic meter of borrow pit soil is required for 50,000 Cu.M compacted fill? (b) Find out the degree of saturation, bulk unit weight and dry unit weight of the undisturbed borrow materials.	8														
3)	A fill is constructed at a site where the soil profile consists of 1 m of sand underlain by a 6 m of clay, resting on rock. The coefficient of Consolidation is $2 \times 10^{-6} \text{ m}^2 / \text{min}$. How long will it take for (i) 50 % of the consolidation to take place? (ii) 90 % of the consolidation to take place?	4														
4)	A normally consolidated clay settled 10 mm when effective stress was increased from 100 kN/m^2 to 200 kN/m^2. Estimate the settlement of this clay when effective stress is further increased from 200 kN/m^2 to 400 kN/m^2.	4														
5)	Write short note:- (a) Classification of soil as per IS Soil Classification System (b) Brief description on the factors affecting compaction (c) Terzaghi's one dimensional consolidation theory and the basic assumptions (d) Time factor and degree of consolidation	4 X 4=16														