



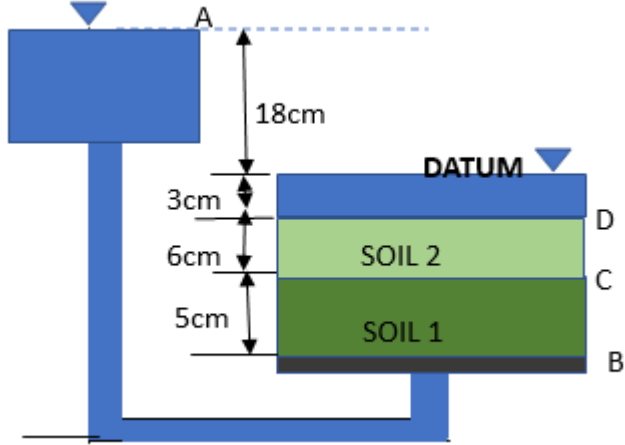
**MANIPAL INSTITUTE OF TECHNOLOGY**  
**FIFTH SEMESTER B. TECH (CIVIL ENGINEERING)**  
**END SEMESTER EXAMINATION, DECEMBER 2023**  
**GEOTECHNICAL ENGINEERING (CIE 3154)**  
**(06 – 12 - 2023)**

**TIME: 3 HRS.**

**MAX. MARKS: 50**

- Note: 1. Answer all questions.**  
**2. Any missing data may be suitably assumed.**

Q. NO	QUESTION	MARK	CO	BL																												
1A	<p>Classify the inorganic soil given in the table below as per IS classification if 1000g of soil sample taken for grain size analysis.</p> <table><tr><th>Soil</th><th>Liquid limit</th><th>Plastic Limit</th><th>Passing 75μ (g)</th><th>Passing 4.75mm (g)</th><th>C<sub>u</sub></th><th>C<sub>c</sub></th></tr><tr><td>A</td><td>46%</td><td>28%</td><td>780</td><td>999</td><td>4</td><td>3</td></tr><tr><td>B</td><td>36%</td><td>21%</td><td>490</td><td>720</td><td>5</td><td>1</td></tr><tr><td>C</td><td>38%</td><td>10%</td><td>40</td><td>660</td><td>7</td><td>2</td></tr></table>	Soil	Liquid limit	Plastic Limit	Passing 75μ (g)	Passing 4.75mm (g)	C <sub>u</sub>	C <sub>c</sub>	A	46%	28%	780	999	4	3	B	36%	21%	490	720	5	1	C	38%	10%	40	660	7	2	4	CO1	4
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1B	A core cutter weighing 8.97N and having volume 10 <sup>-3</sup> m <sup>3</sup> was used to find the in-situ unit weight of an embankment. The core cutter with the sample weighed 28.2N. The lab tests on sample indicated a water content of 12.2% with specific gravity of 2.68. Determine the bulk unit weight, dry unit weight, void ratio and degree of saturation of the sample. If due to rains, the embankment soil is saturated, calculate the water content and saturated unit weight assuming no change in volume of the sample.	3	CO1	4																												
1C	A soil has a liquid limit of 30% and a flow index of 13%. If the plastic limit is 17%, determine the plasticity index and toughness index. If the water content of the soil in its natural condition in the field is 22%, find the liquidity index and the consistency index.	3	CO1	4																												
2A	A saturated specimen of undisturbed clay has a volume of 20 × 10 <sup>-6</sup> m <sup>3</sup> , and weighs 3.3 × 10 <sup>-4</sup> kN. On oven drying, the weight reduced to 2.1 × 10 <sup>-4</sup> kN. Calculate water content, specific gravity, and void ratio.	4	CO1	4																												
2B	<p>The layered sample is having permeability (k) and thickness (z) as follows:</p> <p>First layer: k<sub>1</sub> = 2 x 10<sup>-4</sup> cm/sec, z<sub>1</sub> = 5cm; Second layer: k<sub>2</sub> = 3.3 x 10<sup>-4</sup> cm/sec, z<sub>2</sub> = 8cm; Third layer: k<sub>3</sub> = 6.8 x 10<sup>-4</sup> cm/sec, z<sub>3</sub> = 6cm. Assume flow is perpendicular to planes. Falling head permeability test was conducted on this sample, whose diameter is 12cm. Calculate the time</p>	3	CO2	4																												

	required for head to drop from 140cm to 60cm, if diameter of stand pipe used is 1.4cm.			
2C	A point load of 800kN acts at ground surface. Construct an isobar for vertical stress $30\text{kN/m}^2$ by making use of Boussinesq equation.	3	CO3	4
3A	A homogeneous impermeable dam of 14m height has a free board of 1.5m. A flow net is constructed for flow through soil beneath the dam and the results observed are as follows: Number of potential drops = 16, Number of flow channels = 6. Calculate: i) The discharge/m length if coefficient of permeability of soil beneath the dam is $3.4 \times 10^{-6}$ m/sec, ii) Seepage pressure and pore pressure at the point P located 5m below the ground level having number of potential drop 8.5, and iii) The factor of safety against piping if the length of exit field is 2.4m. Take $G = 2.68$ , void ratio 0.54 and ground level as datum.	4	CO2	4
3B	A soil deposit is 8m deep over an impermeable layer. The ground water table is 5m below the ground surface. The soil deposit has a capillary rise of 1.2 m. Plot the variation of total stress, neutral stress, and effective stress with the deposit of soil. Assume the void ratio and specific gravity of the soil deposit as 0.7 and 2.6 respectively.	3	CO3	4
3C	A soil sample 20 mm thick takes 15 minutes to reach 30 % consolidation. Find the time taken in days for the clay layer 5m thick to reach 50% consolidation. Assume single drainage in both cases.	3	CO4	4
4A	Two different types of soil are placed in a permeameter, and water is allowed to flow under a constant head as shown in figure below. If the internal diameter of the permeameter is 8cm, find the pressure head, datum head and total head at points A, B, C and D, if 30% of the total head causing the flow is lost as water flows through the lower layer. Determine at what value of head will either of the soil be moved out of container or become quick. Take void ratio and specific gravity for Soil 1 as 0.52 and 2.67, and for and Soil 2 as 0.6 and 2.76 respectively. 	4	CO2	4
4B	Explain the square root time fitting method for evaluation of the coefficient of consolidation from laboratory consolidation test.	3	CO4	3
4C	What is the compaction curve? Give its salient features. What is a Zero air void line?	3	CO4	3
5A	A sample fails at $100\text{ kN/m}^2$ axial stress in an unconfined compressive strength test. If an identical sample is tested in triaxial compression	4	CO5	4

	<p>strength test apparatus fails at a deviator stress of <math>140 \text{ kN/m}^2</math> under a cell pressure of <math>30 \text{ kN/m}^2</math>.</p> <p>Estimate the shearing strength of the same soil along a horizontal plane at a depth of 3m, when the ground water table is at a depth of 2m from the ground level. Take the dry unit weight of soil as <math>17.5 \text{ kN/m}^3</math> and specific gravity as 2.65.</p>			
<b>5B</b>	Describe the triaxial shear test. What are the advantages of the triaxial shear test over the direct shear test?	<b>3</b>	<b>CO5</b>	<b>3</b>
<b>5C</b>	<p>A normally consolidated clay layer of 5m thick is located at a depth of 10 m below the ground level. The field water content of the clay is 40% and its liquid limit is 45%. The specific gravity of solid particles is 2.7. The water table is located at 4m below ground level. The soil above the clay is a coarse sand with unit weight above and below the water table <math>17.5 \text{ kN/m}^3</math> and <math>20.5 \text{ kN/m}^3</math> respectively. The increase in vertical stress at the middle of the clay layer due to the superstructure is <math>100 \text{ kN/m}^2</math>, which is constructed on the sand above the clay stratum. Calculate the expected settlement.</p>	<b>3</b>	<b>CO4</b>	<b>4</b>