MANIPAL INSTITUTE OF TECHNOLOGY
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MANIPAL INSTITUTE OF TECHNOLOGY

FIFTH SEMESTER B.TECH (CIVIL ENGINEERING)

END SEMESTER EXAMINATION, NOV 2022

GEOTECHNICAL ENGINEERING (CIE 3154)

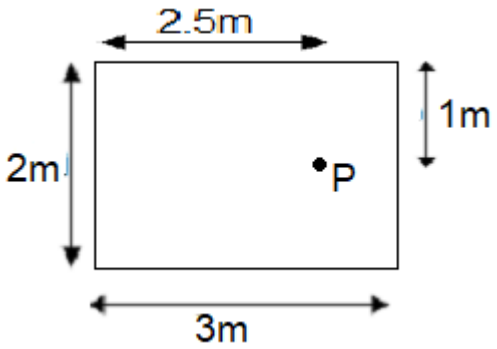
(29–11 - 2022)

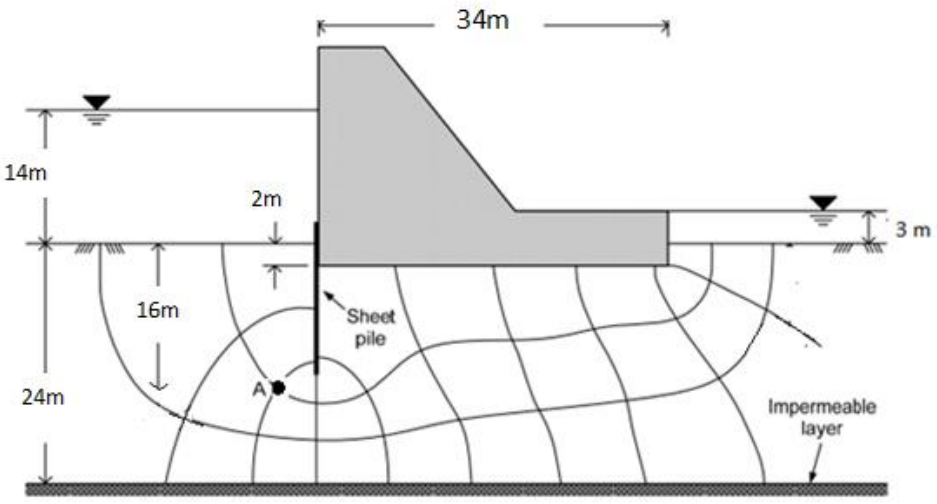
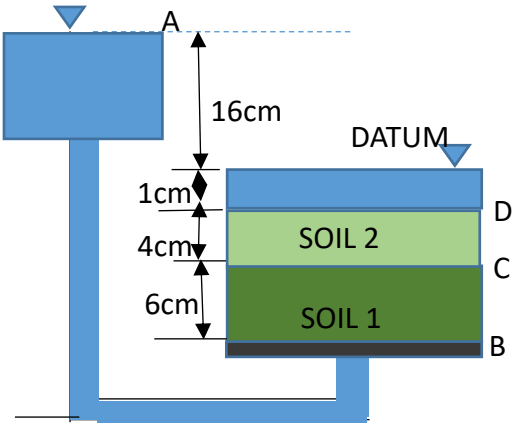
TIME: 3 HRS. **MAX. MARKS: 50**

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

Q. NO	QUESTION	MARKS	CO	BL
1A	A core cutter weighing 9.27N and having volume 10^{-3} m^3 was used to find the in situ unit weight of an embankment. The core cutter with the sample weighed 27.17N. The lab tests on sample indicated a water content of 11.25% with specific gravity of 2.65. 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.	**4**	**CO1**	**4**
1B	Classify the inorganic soil given in the table below as per IS classification if soil sample taken for the test is 1000gms. Write steps for classification.	**3**	**CO1**	**4**
1C	An oven dried sample of 0.5N soil passing through 75 micron was used in a hydrometer analysis. In a 1000ml soil suspension, the corrected hydrometer reading after 3min was 25. If the effective depth H_e for R_H value of 25 is 12.24cm, taking 2.68 as specific gravity of soil solids and viscosity of water as 10^{-6} kN-s/m^2, calculate the diameter of smallest particle and percentage of finer than it at 3 min time interval. How long will it take for a particle of 0.1micron size to settle below a depth of 12.24 cm.	**3**	**CO1**	**4**
2A	Differentiate between flow index and toughness index.	**4**	**CO1**	**3**

Soil	Liquid limit	Plastic Limit	Passing 75μ (g)	Passing 4.75mm (g)	D_{10} (mm)	D_{30} (mm)	D_{60} (mm)
A	49%	34%	750	999	0.001	0.008	0.075
B	37%	19%	460	770	0.002	0.007	0.014

<table>
<tr><td></td><td>The following are the index properties of two soils A and B.
<table><tr><td>Index property</td><td>Soil A</td><td>Soil B</td></tr><tr><td>Liquid limit</td><td>60 %</td><td>31 %</td></tr><tr><td>Plastic Limit</td><td>21 %</td><td>18 %</td></tr><tr><td>Water content</td><td>34 %</td><td>22 %</td></tr><tr><td>Specific gravity</td><td>2.66</td><td>2.63</td></tr><tr><td>Degree of saturation</td><td>100%</td><td>90%</td></tr></table>Which of the two soils (i) contains more clay particles (ii) Has greater void ratio (iii) Has a greater bulk density?</td><td></td><td></td><td></td></tr>
<tr><td>2B</td><td>Differentiate between constant head and variable head permeability tests to determine coefficient of permeability of soil.</td><td>3</td><td>CO3</td><td>3</td></tr>
<tr><td>2C</td><td>A rectangular area shown below carries a uniform pressure of 100 kN/m^2 at the ground surface. Evaluate the vertical pressure at 5m below the point P of the loaded area? Use equivalent point load method.
 
</td><td>3</td><td>CO2</td><td>4</td></tr>
<tr><td>3A</td><td>A flow net for an impervious concrete dam is shown below. The hydraulic conductivity of soil is 4.6 x 10^{-5} cm/sec. Taking downstream water level as datum, void ratio 0.7 and G = 2.7, Evaluate the following:
a. Quantity of seepage
b. Seepage pressure and pore pressure at Point ‘A’
c. If the average length of the field adjacent to the dam is 2.2 m, the maximum exit gradient and the factor of safety against piping.</td><td>4</td><td>CO3</td><td>4</td></tr>
</table>

				
3B	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 9cm, a) Evaluate the pressure head, datum head and total head at points B and C, if 30% of the total head causing the flow is lost as water flows through the lower layer. b) If the permeability of lower layer is 2.1×10^{-2} cm/s, evaluate the rate of discharge and permeability of the top layer. 	**3**	**CO3**	**4**
3C	Evaluate the coefficient of permeability of a soil sample, 7cm in height and $60cm^2$ in cross-sectional area, if a quantity of water equal to 650ml passed down in 14minutes under an effective constant head of 42cm. On oven drying, the specimen weighs 4.78N. Taking the specific gravity of soil solids as 2.65, calculate seepage velocity of water during the test.	**3**	**CO3**	**4**
4A	A clay stratum of 7m thick is located at a depth of 5m below the ground level. The natural moisture content of clay is 30%, its liquid limit is 39% and the specific gravity of soil solids is 2.66. The water table is located at	**4**	**CO4**	**4**

	a depth of 2.5m below the ground level. The soil above and below the clay layer is sand. The unit weight of sand above and below the water table is 17.6 kN/m^3 and 19 kN/m^3 respectively. Due to the construction of a building, the average increase in pressure at the center of the clay stratum is 140 kN/m^2. Evaluate the expected settlement at the centre of the clay layer due to this construction. If coefficient of consolidation of this clay is $2.5x\ 10^{-5}$ m^2/sec, find out how much time is required for 90% consolidation to occur?			
4B	In a consolidation test the void ratio of soil sample decreases from 1.09 to 0.91. When the pressure is increased from 150 to 290 kN/m^2. Evaluate the compression index and coefficient of consolidation if the coefficient of permeability is 5×10^{-5} mm/s.	**3**	**CO4**	**4**
4C	Explain the process of compaction control in field through Proctor needle.	**3**	**CO4**	**3**
5A	In field soil samples were extracted at 4m below ground level. The water table was found to be at 1.8m depth below ground level. The unit weight of soil is found to be 17.2kN/m^3 above water table and 18.8kN/m^3 below water table. This soil sample was tested in unconfined compression strength test and the sample failed at an axial stress of 120 kN/m^2. Further, the soil sample was tested in triaxial compression strength test and failed at an axial stress of 220kN/m^2 when the cell pressure was 80 kN/m^2. Evaluate the shear strength of the soil at a depth of 4m below ground level.	**4**	**CO5**	**4**
5B	Direct shear stress test carried out on a cohesive soil sample gave the following results. Test 1: Normal stress = 66kPa and Shear stress at failure = 95kPa Test 2: Normal stress = 90kPa and Shear stress at failure = 112kPa Evaluate the shearing strength parameters. The same sample was subjected to triaxial test. Evaluate the deviator stress required to induce failure of the soil under a cell pressure of 20 kPa.	**3**	**CO5**	**4**
5C	Differentiate between (i) Primary and secondary consolidation. (ii) Normally and over consolidated clay stratum	**3**	**CO4**	**3**

24m

2m