Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

FOURTH SEMESTER B.TECH. (CIVIL ENGINEERING)

END SEMESTER EXAMINATION, APRIL-MAY 2024

GEOTECHNICAL ENGINEERING [CIE 2221]

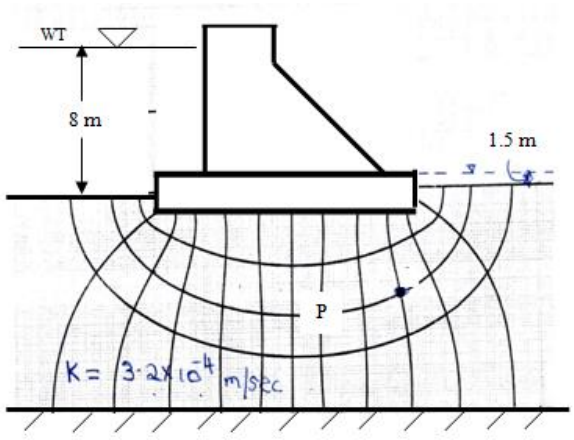
(9 -5 - 2024)

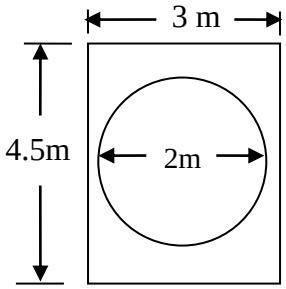
Time: 3 HRS. MAX. MARKS: 50

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

Q. No		MARKS	CO	BL
1A	Differentiate between i) Shrinkage ratio and volumetric shrinkage ii) Illustrate the procedure to obtain relationship between degree of saturation (*Sr*), void ratio (*e*), water content (*w*) and specific gravity (*G*)	3	1	2
1B	i) Saturated specimen of undisturbed clay has a volume of 3.465×10^{-4} m^3 and its weight is 9.22×10^{-3} kN. After oven drying the weight reduces to 6.8×10^{-3} kN. Evaluate i) water content ii) dry unit weight ii) Evaluate the weight of soil and water required to prepare a soil sample of diameter 0.1 m, height 0.2 m with voids ratio 0.3 and water content 12%. Specific gravity of soil solids is equal to 2.7.	4	1	3
1C	50 gms of oven dried soil is taken for hydrometer analysis. The hydrometer reading in 1000 ml soil suspension after 20 minutes interval is 1.02 and the corresponding effective height is 12 cm. If specific gravity of soil solids is equal to 2.7 and viscosity of water is 1×10^{-6} kNsec/m^2 , evaluate i) the effective diameter of soil particles corresponding to 20 minutes reading ii) percentage finer than this diameter	3	1	3
2A	Classify the soil as per IS soil classification system with the data given in the following table	2	1	3
2B	A soil profile consists of 3 m depth of sand above the clay stratum. The specific gravity and porosity of sand deposit is 2.6 and 40% respectively. The clay stratum has void ratio of 0.6 and specific gravity 2.7. Water table is at the ground level. Evaluate the total and effective stresses at 5 m below ground level. What is the total and effective stresses at 5m from ground level if the water table rises 1 m above ground level due to rain.	4	3	3

% retained on 4.75 mm sieve	% passing through 0.075 mm sieve	D10 (mm)	D30 (mm)	D60 (mm)	Liquid limit (%)	Plastic limit (%)
10	15	0.1	0.24	1.2	25	8

<table>
<tr><td>2C</td><td>Figure shows the flow net under weir. If coefficient of permeability of the soil below weir is $6x10^{-5}$ cm/sec, evaluate
i) quantity of seepage
ii) seepage pressure at point P
iii) hydrostatic pressure at point P if the depth of point P from ground level is 4 m
iv) exit gradient if the length of last field is 0.6 m
  </td><td>4</td><td>2</td><td>3</td></tr>
<tr><td>3A</td><td>600 cm^3 of water passes through a soil of height 8 cm and 40 cm^2 in c/s area in 30 minutes under an effective head of 60 cm. Evaluate the coefficient of permeability of soil. If the void ratio of soil is equal to 0.6, what is the seepage and discharge velocity.</td><td>3</td><td>2</td><td>3</td></tr>
<tr><td>3B</td><td>Table shows the results obtained from standard proctor test. Tabulate the values required to plot the compaction curve and obtain maximum dry unit weight and optimum water content. What is the percentage air voids and air content at water content of 12%. Take G=2.7
<table><tr><td>water content (%)</td><td>10</td><td>12</td><td>14</td><td>16</td></tr><tr><td>Weight of compacted soil(kN)</td><td>0.0166</td><td>0.0173</td><td>0.0192</td><td>0.0182</td></tr><tr><td>Volume of mould (m^3)</td><td colspan="4">$9x10^{-4}$</td></tr></table></td><td>3</td><td>4</td><td>3</td></tr>
<tr><td>3C</td><td>Results obtained from triaxial compression strength test are as follows. Determine the values of cohesion and angle of internal friction for the soil. If the similar soil specimen fails at shear stress of 150 kN/m^2 in box shear test, what is the normal stress applied to the soil sample
<table><tr><td>Trial No</td><td>Cell pressure (kN/m^2)</td><td>Deviator stress (kN/m^2)</td></tr><tr><td>1</td><td>100</td><td>388</td></tr><tr><td>2</td><td>200</td><td>492</td></tr><tr><td>3</td><td>300</td><td>595</td></tr></table></td><td>4</td><td>5</td><td>3</td></tr>
<tr><td>4A</td><td>A specimen of clay failed under an axial stress of 200 kN/m^2 in an unconfined compression strength test. If the failure plane makes an angle of 57° with</td><td>3</td><td>5</td><td>3</td></tr>
</table>

	horizontal, evaluate values of cohesion and angle of internal friction for the soil. Also illustrate the graphical method to determine the values of cohesion and angle of internal friction.			
4B	Illustrate i) deviator stress ii) drained test iii) undrained test iv) limitations of box shear test	**3**	**5**	**2**
4C	Illustrate the procedure to obtain i) pre consolidation pressure ii)coefficient of consolidation using square root of time fitting method	**4**	**4**	**2**
5A	A saturated specimen of clay 6 m thick has compression index of 0.2 and coefficient of permeability of $6x10^{-7}$ m/sec. The voids ratio of the soil at a stress of 200 kN/m^2 is 1.2 and drainage is provided both at top and bottom. Evaluate i)Change in void ratio when the stress is increased to 500 kN/m^2 ii)Settlement of the soil due to the above increase in stress iii) Time required for 40% consolidation	**4**	**4**	**3**
5B	A rectangular footing of size 3m x 4.5m has a circular hole of diameter 2m as shown in the figure. Evaluate the vertical stress at the center of footing at a depth of 1.5 m from ground level due to uniformly distributed load of 200 kN/m^2. 	**4**	**3**	**3**
5C	Illustrate i) flow lines ii)equipotential lines iii) properties of flow net	**2**	**2**	**2**