Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

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V SEMESTER B.TECH (CIVIL) END SEMESTER EXAMINATIONS
JANUARY 2021
SUBJECT: GEOTECHNICAL ENNGINEERING [CIE 3154]

Date of Exam: **28/01/2021** Time of Exam: Max. Marks: **50**

Instructions to Candidates:

- Answer ALL the questions & missing data may be suitably assumed

1A. Classify the following inorganic soils as per IS soil classification system based on the data provided,

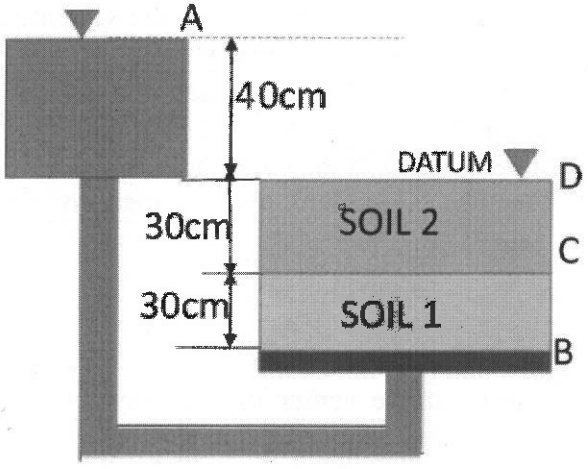
Soil	% passing 75micron	% retained on 4.75mm	C_C	C_U	Liquid Limit (%)	Plastic Limit (%)
L	8	35	2.5	7	15	12
M	23	45	3.2	5	32	22
N	58	2	2	4.1	40	25.4

Also differentiate between uniformly graded and gap graded soil. **5** **CO1**

1B. For soil in its natural state e = 0.8, w =24% and G = 2.68. Determine bulk unit weight, dry unit weight and degree of saturation. Also determine the moisture content and saturated unit weight of soil. **3** **CO1**

1C. Using first principle, derive the equation for submerged unit weight $\gamma' = \frac{(G-1)}{(1+e)} \cdot \gamma_w$ **2** **CO1**

2A. In a permeability test the flow takes place under a constant head through soils 1 and 2 as shown below.



(a) Find the peizometric head at B

(b) If 30% of hydrostatic pressure is lost while flowing through soil 1, what would be the hydraulic head and peizometric head at point C?

5 **CO2**

	(c) If coefficient of permeability of soil 1 is 0.05 cm/s, what will be the permeability for soil 2? (d) What is the discharge per unit area through soil 1 and 2 ? (e) Find the discharge velocity per unit area through each soil.		
2B.	In a falling head permeability test for a two layered soil, determine the time required for the head to fall from 110cm to 42cm. The diameter of the sample is 80mm and diameter of standpipe used is 4mm.The permeability (k) and thickness (z) of the soil layers are as follows: First layer: $k_1 = 5 \times 10^{-3}$ cm/sec, $z_1 = 60$cm; Second layer: $k_2 = 17 \times 10^{-3}$ cm/sec, $z_2 = 40$cm. Assume flow to be perpendicular to the soil layers.	**3**	**CO2**
2C.	Excavation is carried out in a soil with a void ratio of 0.67 and the specific gravity of solids of 2.65, determine the critical gradient. A 2 m layer of the soil is subjected to an upward seepage head of 1.6m. What depth of coarse sand would be required above the soil to provide a factor safety of 1.5? Assume that sand has the same porosity and specific gravity of solids as the soil.	**2**	**CO2**
3A.	Give reasons for i) Determination of the preconsolidation pressure of a soil. ii) Water is to be added during compaction of the soil. iii) The permeability of soil decreases when compacted. iv) Optimum moisture content of fine grained soils is more than that of coarse grained soils. v) Compression index indicates the compressibility of soil.	**5**	**CO4**
3B.	Explain with neat sketch the Mohr circle for a cylindrical sample in an unconfined compression test and mark the pole, the failure plane and the plane on which major and minor principal stresses act.	**3**	**CO5**
3C.	A specimen of fine dry sand, when subjected to a triaxial compression test failed at a deviator stress of 350kN/m^2. If the failure plane makes an angle of 36° with the axis of the sample, compute the lateral pressure to which the specimen would have been subjected.	**2**	**CO5**
4A.	A normally consolidated clay stratum 8m thick is located at a depth of 10m below the ground level. The water content of clay is 35% and its liquid limit is 42%. The specific gravity of solid particles is 2.73. The water table is located at a depth of 3.5m below ground level. The soil layer above clay is made of two layers and details are as follows Layer 1: 0 – 6m, $\gamma = 18$kN/m^3, $\gamma_{sat} = 19.5$kN/m^3. Layer 2: 6m – 10m, $\gamma_{sat} = 20.1$kN/m^3. The average increase in pressure at the center of the clay layer is 100kN/m^2. Estimate the expected settlement at the center of the clay layer. Also determine the increase in pressure required to cause a settlement of 0.3m at the center of clay layer if water table rises to ground level.	**5**	**CO4**
4B.	Direct shear stress test is carried out on sample of sand and the angle of internal friction is found to be 32° at a unit weight of 19 kN/m^3. If the sample was extracted	**3**	**CO5**

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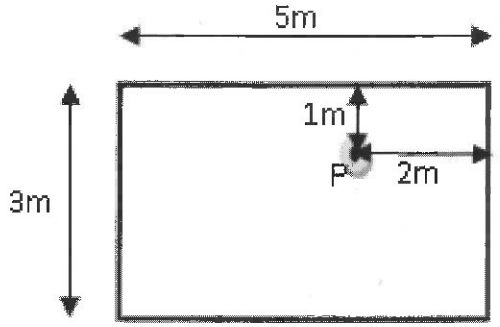
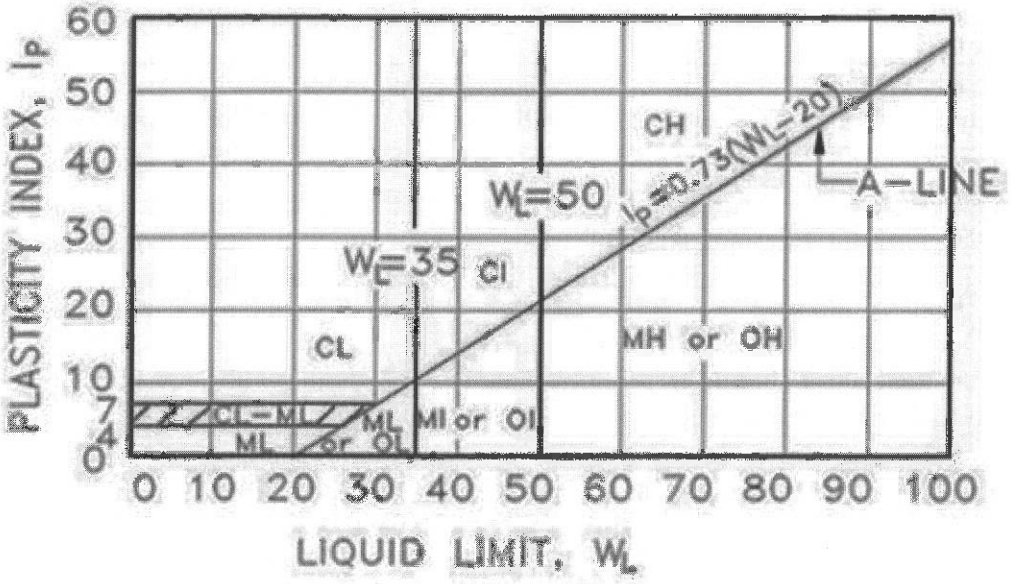
	from a horizontal plane at a depth of 4m below ground level, what will be the shear strength of the soil if the water table is 10m below the ground level? A construction is proposed at this site which will cause the vertical stress and shear stress to be 62 kN/m^2 and 46 kN/m^2 respectively at 4m depth. Check if the shear stress of soil at the depth 4m below the ground level will exceed the shear strength if the water table is at the ground. Assume that the unit weight remains same even after saturation. Will the construction be safe? Why?		
4C.	In a sand stratum 8m thick having water table at 3m below ground level, capillary rise occurs for 1m depth above water table. The dry unit weight and saturated unit weight of sand layer are 18kN/m^3 and 21kN/m^3 respectively. Calculate the effective stress at 0m, 2m, 3m and 8m from the ground level	**2**	**CO3**
5A.	In a triaxial compression test the sample yielded the following results Confining pressure kN/m^2: 20, 30, 40 Deviator stress at failure kN/m^2: 30.2, 35, 40 Determine the shear strength parameters using i) Analytical method considering the first two trials ii) Graphical method	**5**	**CO5**
5B.	A rectangular area shown below is uniformly loaded with intensity of 90kN/m^2 at ground surface. Calculate vertical stress at a point "**P**" 2.5m below ground surface using Equivalent point load method. 	**3**	**CO3**
5C.	The liquid limit and plastic limit of a soil are 62% and 28% respectively. The soil has 26% of particles finer than 2μm and the natural water content is 24%. Calculate the liquidity index and activity number. Comment on the consistency, plasticity and activity of soil.	**2**	**CO1**



Plasticity Chart