MANIPAL INSTITUTE OF TECHNOLOGY
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MANIPAL INSTITUTE OF TECHNOLOGY

SIXTH SEMESTER B.TECH (CIVIL ENGINEERING)

END SEMESTER EXAMINATION, MAY 2023

APPLIED SOIL ENGINEERING (CIE 3251)

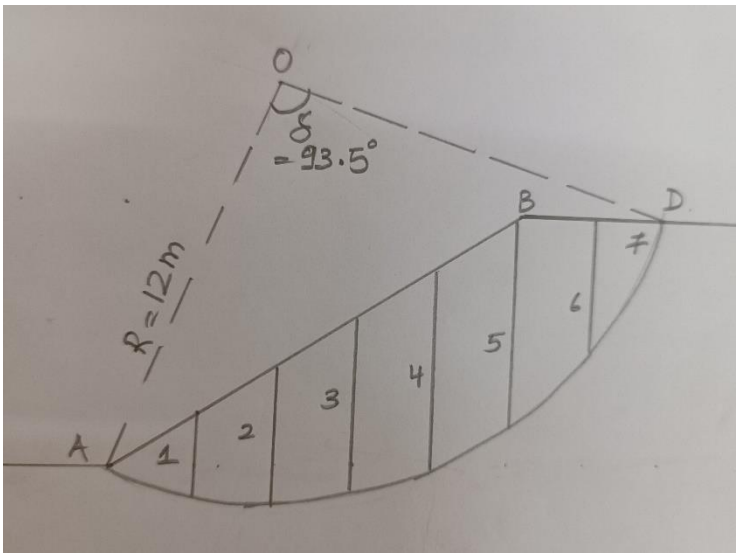
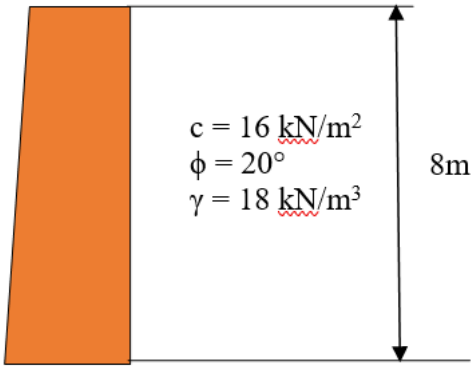
(25 – 05 - 2023)

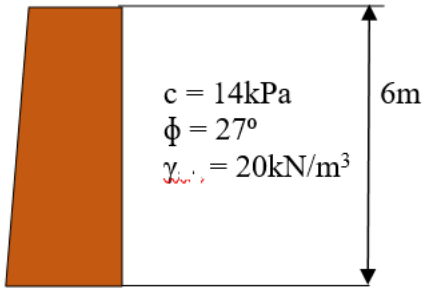
TIME: 3 HRS. **MAX. MARKS: 50**

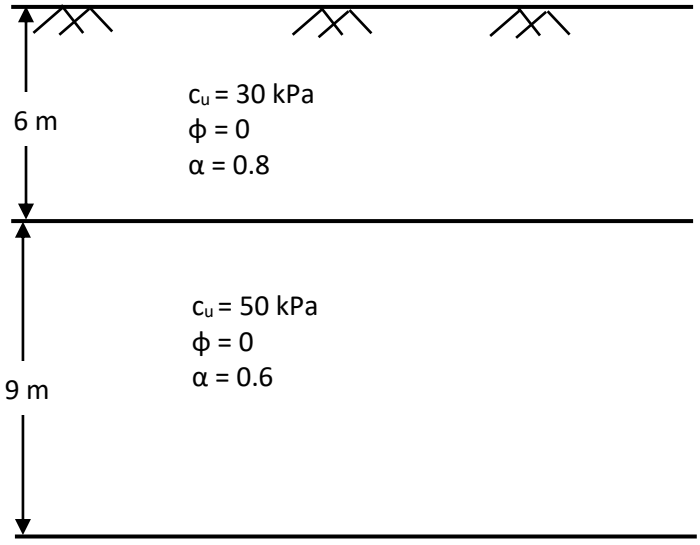
Note: 1. Answer all questions.
2. Any missing data may be suitably assumed.

Q. NO	QUESTION	MARKS	CO	BL
1A	A retaining wall supports a 9m high soil backfill made of two layers of soil. The top layer of 4m depth is cohesive soil with a cohesion of 26kPa, bulk unit weight of 18kN/m^3 and saturated unit weight of 20kN/m^3. The bottom layer of 5m depth is cohesionless with angle of internal friction 36°, bulk unit weight of 17kN/m^3 and saturated unit weight of 19kN/m^3. Assuming back of the retaining wall to be smooth, analyze for total active earth pressure magnitude and its point of application when water table is located at 6m below the top of retaining wall.	**5**	**2**	**4**
1B	An infinite slope of 14m height with side slopes of 1:1.5 in a saturated clay has soil properties as c'=32.5kPa; ϕ'=22°; and γ_{sat}=20kN/m^3. Determine the factor of safety with respect to cohesion when the slope is completely submerged and when there is a steady seepage parallel to the surface of slope. Comment on the results and find the critical height of the slope for both conditions.	**3**	**3**	**4**
1C	Discuss the various types of soil samplers for obtaining undisturbed samples.	**2**	**1**	**2**
2A	An embankment is constructed having following soil properties c = 26 kN/m^2, ϕ = 28° and γ = 18.4 kN/m^3. For the slip surface shown in the figure, evaluate the factor of safety against sliding using method of slices with mid-ordinate and angles of each slices as given below. All slices are of 3m width.	**5**	**3**	**4**

Slice no	1	2	3	4	5	6	7
Mid-ordinate, h (m)	1.7	4.2	6	7.2	7.8	9.2	3.4
Angle, θ°	-12	-4	6	17	29	43	60

				
2B	A strip footing is to be designed to carry a gross safe load of 1200kN at a depth of 1.2m. The shear strength parameters are c = 12kN/m^2 and ϕ =36º. Evaluate the width of footing if a factor of safety of 3 against shear failure and assume water table is at foundation level. The unit weight of soil above and below water table are 17.4 kN/m^3 and 19kN/m^3 respectively. Use Terzaghi's analysis. Assume general shear failure.	**3**	**4**	**4**
2C	Evaluate the surcharge load to be applied to remove the tension in the following retaining wall. 	**2**	**2**	**3**
3A	Discuss the different factor of safety used in stability analysis of slope. A clay slope with inclination 35° with respect to horizontal has a height of 7 m. Assume a toe circle failure occurs and hard layer lies at a depth of 3.5m from toe level. Using Taylor's stability number, i) Calculate the cohesion required and mobilized cohesion for the soil for a factor of safety of 1.5. Take γ= 18.6 kN/m^3. ii) Determine the steepest slope that can be provided if the above slope is in submerged condition (γ_{sat}= 20.3 kN/m^3) and the required factor of safety is 3.	**5**	**3**	**4**

3B	A circular footing of 1.8m diameter is laid at a depth of 1.5m below the ground level. The foundation soil has unit weight of 18.5kN/m^3 above water table and 19.5 kN/m^3 below water table, ϕ = 30º and cohesion of 12kN/m^2. Estimate the gross safe load the footing can carry if factor of safety is 2. Water table is at ground level. Use Terzaghi's analysis and assume general shear failure.	**3**	**4**	**4**
3C	Evaluate the total passive earth pressure for the retaining wall shown below. 	**2**	**2**	**4**
4A	Evaluate the net ultimate bearing capacity for a rectangular footing of size 1.5m × 2.5m provided at depth of 1.2m in a soil with c=15kN/m^2, ϕ=26˚, γ_{sat}=21kN/m^3 , γ=18kN/m^3 when the water table is (a) at 1m below GL and (b) at the base of the footing. Load is inclined at 10˚ to the vertical. Use IS code method. Assume local shear failure.	**5**	**4**	**3**
4B	Square footing is required to carry a net load of 1000kN. Evaluate the size of footing if it is to be laid at a depth of 2m and the tolerable settlement is 40mm.The soil is sandy with corrected SPT value of N = 14. Take water table at 10m below GL and FOS = 3. Use Teng's equation.	**3**	**4**	**4**
4C	What are the conditions where a pile foundation is more suitable than shallow foundations?	**2**	**5**	**3**
5A	Compute the settlement of a square pile group assuming the load to be transferred at 2/3 length of the pile and 30 degree distribution for the following data: Load = 2500 kN, diameter of the pile=400 mm, No. of piles=9, Length of the pile=12 m, Center to center spacing of piles=1.2m. Hard rock is at a depth of 18 m from GL. Soil properties: Liquid limit=55%, Unit weight of soil 17.5 kN/m^3 and initial void ratio as 0.9. Assume three layers of equal thickness for the calculation of settlement.	**5**	**5**	**4**

5B	A square group of 16 piles was installed in layered soil deposit as shown figure. The diameter of each pile is 450 mm and their c/c distance is 0.9 m. The length of the pile group is 15m. Estimate the safe load capacity of the group with a factor of safety of 2.0.  	**3**	**5**	**4**
5C	What is negative skin friction? What is the effect of negative skin friction on the load carrying capacity of piles?	**2**	**5**	**2**