Ref. No. : Ex/CE/PE/B/T/421C/2023

B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER-2023
SUBJECT: ADVANCED FOUNDATION ENGINEERING

Time : Three hours | Full Marks : 100

(50 Marks for each Part)
Use separate answer script for each Part

PART I (50 Marks)
Assume reasonable values of data not supplied

C.O.2
Q 1. A number of well foundations are to be constructed in connection with a bridge project across a river of effective waterway of 120m, maximum discharge 2400 m^3/sec, HFL 100.00m and existing bed level at 88.00m R.L. The subsoil consists of loose silty sand layer (N_{corr} = 10), 3.5m thick, underlain by a thick stratum of medium to coarse sand (N_{corr} = 24). Determine the founding level of a 6.0 m diameter well. The weighted mean diameter of the river bed soil down to relevant depth is 0.275 mm. Use Teng's equation for determining allowable bearing capacity of the well foundation. 7+5=12

C.O.3
Q 2. A 20m wide and 12m deep braced excavation is to be constructed in connection with underground metro project at a site with the soil profile given below. Take a surcharge of 2 t/ m^2 on the ground level. Horizontal struts are provided at 2.0m, 6.0m and 10.0m below ground level. Take horizontal spacing of struts 4m c/c.

Stratum I : Soft clay of thickness 15.0m with undrained cohesion Cu = 25kPa, γ_{sat}=17kN/m^3, Cc/1+e0 = 0.14.
Stratum II : Stiff over-consolidated clay with undrained cohesion Cu = 75kPa, γ_{sat}=19kN/m^3, Cc/1+e0=0.07 down to 20.0m below ground level.
Stratum III: A deep deposit of sand (below 20.0m) of angle of shearing resistance 34^0 and bulk density 19.5kN/m^3.
GWT is at the ground level.

a. Check the stability of excavation.
b. Draw the earth pressure diagram on the braced wall.
c. Determine the magnitude of horizontal forces in the struts, design moments and forces in the waler beams and diaphragm wall. 10+5+10=25

C.O.5
Q 3. A steel storage tank 30m diameter x 12m high is to be founded on subsoil deposit given in Q. 2. The formation level of the ground is to be raised by 1m sand fill prior to construction. The soil is proposed to be treated by 0.80m diameter and 15m long stone column placed at a spacing of 1700mm c/c.

a. Determine the safe bearing capacity of the foundation soil reinforced with stone column.
b. Estimate the corresponding consolidation settlement of the tank if the average pressure below the tank is 8 t/m^2. 6+7=13

[Turn over

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Time : Three hours **(50 Marks for each Part)** Full Marks : 100

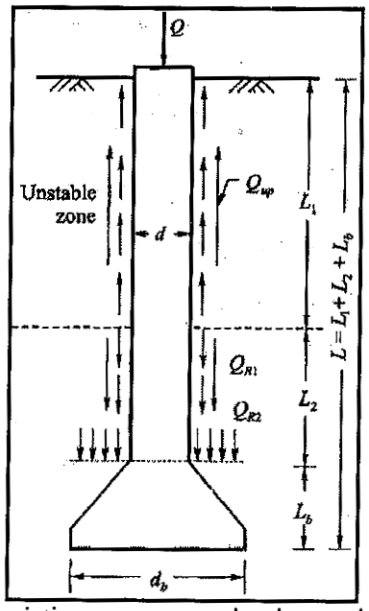
No. of Question

Part –II

CO Marks

1) *Answer all questions*
2) *Assume reasonable values of data not supplied*
3) *Answer the **Part I** and **Part II** separately*
4) *There is no need of any code etc for answering **Part II***

Sl. No.	Question	CO	Marks
1 (a)	What is the equation for uplift force Q_{up} for pier as per Chen (1988)? Here the figure shows a drilled pier [refer to Fig. shown] with a belled bottom in expansive soil. The water table is not encountered. The details of the pier and soil are: L_1 = 3.05 m, L_2 = 3.05 m, L_b = 0.760 m, d= 0.305 m, d_b= 0.9 m, p_s = 480 kN/m^2, c_u = 96 kN/m^2, γ = 17.3kN/m^3, **Required:** (a) total uplift force Q_{up}, (b) total resisting force Q_R, (c) factor of safety for Q =0 at the top of pier, (d) factor of safety for Q =90 kN at the top of pier (assume α = 0.55)	[CO1]	[1+8]
1 (b)	Which characteristics are commonly observed for metastable soils?	[CO1]	[5]
1 (c)	Which factors are needed to produce collapse in a soil structure according to Dudley and Barden et al.? or Presently which recognitions geotechnical engineers are giving regarding the behaviour of compacted collapsing soils?	[CO1]	[6]



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(50 Marks for each Part)
PART II (50 Marks)

Answer any three from 2(a), 2(b), 2(c) and 2(d).

2 (a)	What are the key things to consider when designing and planning a pumping test?	[CO4]	[5]
2 (b)	When are pumping tests needed?	[CO4]	[5]
2 (c)	What information should a pumping test (field pumping test) report cover?	[CO4]	[5]
2 (d)	Are there natural variations in the groundwater levels? What time of year should a pumping test be done?	[CO4]	[3+2]
3 (a)	What is meant by the term "ground improvement"?	[CO5]	[3]
3 (b)	Discuss about the principles of the ground improvement.	[CO5]	[5]
	or		
	Explain the term "groutability ratio".	[CO5]	[5]
3 (c)	What is meant by the term "grouting"?	[CO5]	[3]
3 (d)	Discuss about any two of the following threes: (a) soil grouts, (b) cement grouts (c) Chemical grouts.	[CO5]	[4]

End of Questions