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

B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER

SUPPLEMENTARY EXAM – 2023

SUBJECT: ADVANCED FOUNDATION ENGINEERING

Time: 3 HOURS Full Marks : 100

(PART- I 50 MARKS)

Use separate Answerscript for each part

Assume reasonable values of data not supplied

C.O.2

Q 1. In connection with a bridge project a number of well foundations are to be constructed across a river of effective waterway of 125m, maximum discharge 2500 m^3/sec, HFL 100.00m and existing bed level at 87.00m R.L. The subsoil consists of loose sandy silt / silty sand layer (N_{corr} = 13), 3.5m thick, underlain by a thick stratum of coarse sand (N_{corr} = 34). Determine the founding level of a 8.0 m diameter well. The weighted mean diameter of the river bed soil down to relevant depth is 0.293 mm. Use Teng's equation for determining allowable bearing capacity of the well foundation. 7+5=12

C.O.3

Q 2. In connection with underground metro project a 25m wide and 12m deep braced excavation is to be constructed at a site with the soil stratification and average soil properties given below. Take a surcharge of 5 t/ m^2 on the ground level. Horizontal struts are provided at 2.5m, 6.5m and 10.5m below ground level. Take horizontal spacing of struts 4m c/c.

Stratum I : Soft silty clay / clayey silt of thickness 16.0m with undrained cohesion Cu = 24kPa, γ_{sat}=17.2kN/m^3, $Cc/1+e_0$ = 0.14.

Stratum II : Stiff silty clay / clayey silt with undrained cohesion Cu = 70kPa, γ_{sat}=19kN/m^3, $Cc/1+e_0$=0.08 down to 22.0m below ground level.

Stratum III: A deep deposit of sand (below 22.0m) of angle of shearing resistance 34^0 and bulk density 19.5kN/m^3 (N> 40 blows/30cm)

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 40m diameter x 11m 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 0.85m diameter and 16.5m 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 consolidation settlement of the tank if the average pressure below the tank is 12 t/m^2. 6+7=13

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SECOND SEMESTER SUPPLEMENTARY EXAM 2023
SUBJECT: **ADVANCED FOUNDATION ENGINEERING**
(Name in full)

PAPER ××××

Time: Three hours **Full Marks =100**
(35 marks for part I and 50 Marks for part II)

No. of Question	***Part –II***	**CO**	**Marks**

1) Answer all questions from Section A and any five MCQs from the available 10 MCQs in Section B.
2) Assume reasonable values of data if it is not supplied,
3) In the cases where excess number of questions will be answered exceeding the required number of question/s, the first required number of question/s will be evaluated only.

Section A

Sl. No.

Answer from 1(a), 1(b).

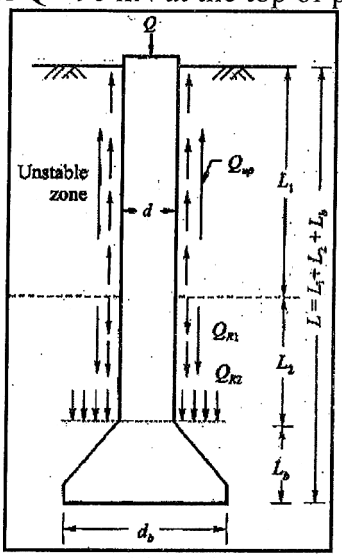
1 (a) Write down the equation for uplift force Q_{up} for pier as per Chen (1988)? [CO1] [1+8]

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:

$L_1 = 2.75$ m, $L_2 = 3.35$ 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, $\gamma = 17.3$kN/m^3,

Calculate:

(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 $\alpha = 0.52$)



(b) When soil is termed as metastable soils? What are the examples of the metastable soils? [CO1] [2+4]

Or

What is meant by free swell? Why the tendency of swelling is not safe for foundations? [CO1] [3+3]

Answer from 2(a), 2(b), 2(c).

2 (a) What should be in a pumping test report? [CO4] [5]

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(b)	When are pumping tests needed? Or Who can interpret pumping test data?	[CO4]	[5]
(c)	Are there natural variations in the groundwater levels? In what time of year can a pumping test be carried out?	[CO4]	[3+2]

Answer from 3(a), 3(b), 3(c).

3 (a)	Discuss about the principles of the ground improvement. Or What are the objectives of the ground improvement?	[CO5]	[5]
(b)	What is meant by "groutability ratio"?	[CO5]	[5]
(c)	Discuss about any two of the following threes: (a) soil grouts, (b) cement grouts (c) Chemical grouts.	[CO5]	[5]

Section B

Choose the correct alternative/ alternatives for any five MCQs from the following 10 MCQs (if more than 5 MCQs will be answered, then **only the first 5 answered MCQs will be evaluated** and the rest answered MCQs will be ignored)**:**

MCQ (1)	An open, unsaturated and partly unstable fabric of soil helps in (a) Making the soil metastable, (b) Making the soil to be collapsible, (c) Both (a) and (b), (d) None of the above.	[CO1]	1
MCQ (2)	Pretreatment technique of soil is being applied for (a) Stabilizing the soil only, (b) Collapsing the soil deposit to some degree, (c) Both (a) and (b), (d) None of the above.	[CO1]	1
MCQ (3)	The collapse of the soil is associated with (a) Localized shear failure of the soil mass, (b) Overall shear failure of the soil mass, (c) Both (a) and (b), (d) None of the above.	[CO1]	1
MCQ (4)	Most economical method of dewatering is: (a) Open sump method, (b) Deep Well method, (c) Well point method, (d) Both (a) and (b), (e) Both (b) and (c).	[CO4]	1
MCQ (5)	When well yield is low, then more reliable test is: (a) Well yield test, (b) Pumping test,	[CO4]	1

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(35 marks for part I and 50 Marks for part II)

(c) Both (a) and (b),
(d) None of the above.

MCQ (6) In metastable soils: [CO1] 1
(a) Large loss of shear strength occurs at small changes in stress,
(b) Large loss of shear strength occurs at small changes in deformation,
(c) Great increase in compressibility occurs at small changes in stress,
(d) Great increase in compressibility occurs at small changes in deformation,
(e) Both (a) and (b),
(f) Both (c) and (d),
(g) All from the (a) to (d),
(h) None of the above.

MCQ (7) Under Triaxial stress-state, the magnitude of volumetric strain originating from a change in stress state depends on: [CO1] 1
(a) Principal stress ratio,
(b) Mean normal total stress,
(c) Both (a) and (b),
(d) None of the above.

MCQ (8) To maximize the amount of drawdown for the pumping test, the pump is normally placed: [CO4] 1
(a) Below the well screen,
(b) At the level of the well screen,
(c) Above the well screen,
(d) All the above.

MCQ (9) "Any type of soil compacted at _____ of optimum conditions and at a _____ dry density may develop a collapsible fabric." – in this statement the blank spaces should be filled by the following two words: [CO1] 1
(a) "wet" and "low",
(b) "dry" and "high",
(c) "dry" and "low",
(d) "wet" and "high".

MCQ (10) "A compacted and metastable soil structure is supported by _____ of the shear strength that is _____, which are highly dependent upon capillary action." – in this statement the blank spaces should be filled by the following two words: [CO1] 1
(a) "macro-forces " and "bonds",
(b) "micro-forces " and "bonds",
(c) "micro-forces " and "attraction",
(d) "macro-forces" and "attraction".

End of Questions