Ref. No. Ex/CE/5/T/505B/2023

Bachelor of Engineering (Civil Engineering)
[5th Year; 2nd Semester Examination - 2023]
Advanced Foundation Engineering

Total Time: Three Hours | Full Marks 100 (Part I: 50 + Part II: 50)

Use a separate Answer-Script for each part

Part I (50 Marks)

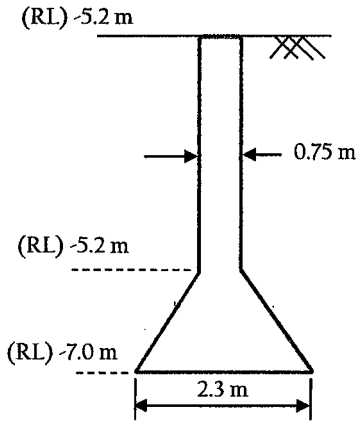
Answer all in brief and to-the-point (Assume any relevant data if not provided, but required)

1 Mention different remedial methods for founding a foundation system on an expansive soil with proper justification. (5)

2 Refer to the soil properties provided on a swelling type soil at a site. A drilled pier-bell foundation system is proposed for the site to carry a Dead Load of 1200 kN and a Live Load of 1000 kN. The dimension of the Belled Pier is given in the figure. Check the proposed proportion of the belled foundation system if FOS of 1.2 is to be provided against uplift of pier alone before construction and a FOS of 2.0 under the dead load of the superstructure. Ignore the dead weight of the pier. (25)

Borehole Data:

Depth from EGL (m)	Soil Description and other relevant data
3.7	Hard clay, with slickensides $q_{u(av)}$ = 600 kN/m^2 C_a = 300 kN/m^2
7.0	Intact clay
9.0	Use, $q_{u(av)}$ = 700 kN/m^2 for the bearing capacity at base



Proposed Belled Pire

Lab Test Data:

Avg. LL = 60%
Avg. PL = 20%
Normal MC = 10% - 20%
Swelling Pressure linearly varied from 0 to 240 kN/m^2 for % of swell variation from 8 % to 0%, respectively.

3 (a) Draw a typical well foundation indicating its components. (5)

(b) Mention the precautions that are useful in avoiding tilts and shifts in wells. (5)

(c) Mention, with justification, the methods that are useful in rectifying the tilt and shift in wells. (5)

4 What are the forces to be considered while designing a well foundation? Explain in details. (5)

[Turn over

Ref. No.: Ex/CE/5/T/505B/2023

B. E. (CIVIL ENGINEERING) FIFTH YEAR SECOND SEMESTER – 2023

ADVANCED FOUNDATION ENGINEERING

Time: Three Hours

Full Marks 100
Part I: 50 Marks
Part II: 50 Marks

Use Separate Answer-Scripts for each Part

Question No.	Part II (50 Marks)	Marks

*Answer **ALL** questions from this Part. Assume reasonable values of data, if not supplied.*

1. a) Explain the working of a single-stage well-point system with the help of a neat sketch. What are its limitations? 5+2

   b) Derive the expression for discharge from a fully penetrating slot under gravity flow. 8

   c) A slot is made in a confined aquifer 2 m thick to drain water. The flow to the slot occurs from both sides. If the water table is at a height of 10 m above the base and the drawdown is 3 m, find the discharge per metre length, assuming that the distance of the slot from both sides is 120 m. Assume coefficient of permeability = 4×10^{-4} m/s. 5

2. a) A 4 m × 10 m deep and 12 m long trench, will be excavated in a soil deposit of $\gamma = 18.5$ kN/m^3, $c = 35$ kN/m^2, and $\phi = 0°$ extending up to a depth of 3 m below G.L. underlain by a clayey soil layer with $\gamma = 19.5$ kN/m^3, $c = 75$ kN/m^2 and $\phi = 0°$ extending to a great depth, for the foundation of a multi-storied building with a basement. The sides of the trench are to be supported with sheet pile walls fixed in place by struts and wales. The first row of the strut is located at a depth of 2 m below G.L. The bottom of the cut is at a depth of 3 m below the bottommost row of the strut. In each row, the horizontal spacing of the strut is 3 m centre to centre. 15

      a) Estimate the average cohesion (c_{av}) and average unit weight (γ_{av}) for the construction of the pressure envelopes.

      b) Plot the apparent pressure envelopes.

      c) Determine the strut loads at different strut levels.

      d) Determine the factor of safety against bottom heaving

   b) Describe the different types of apparent lateral pressure diagrams used for the design of cuts in sand and clay. 5

3. a) What is the critical damping and damping factor? What is the use of frequency ratio in machine foundation design? 3+2

   b) A machine and its foundation weigh 160 kN. The spring constant and the damping ratio of the soil supporting the soil may be taken as 14×10^4 kN/m and 0.2, respectively. Forced vibration of the foundation is caused by a force that can be expressed as 5

   Q (kN) = $Q_0 \sin\omega t$, where, $Q_0 = 48$ kN, $\omega = 163$ rad/s

   Determine the undamped natural frequency of the foundation and the amplitude of motion.