Ref. No. **Ex/CE/5/T/505B/2024**

Bachelor of Engineering (Civil Engineering)

[5th Year; 2nd Semester Examination - 2024]

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)

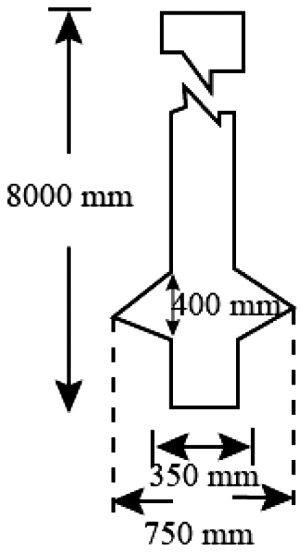
(Codes are NOT Allowed)

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

1 Explain the behavior of expansive soil with respect to the mineralogical composition of soil. What could be adopted to overcome the possible problems that can cause problems in civil engineering structures due to shrinking-swelling characteristics of soils? (10)

2 Explain the parameters given in the ultimate load-bearing capacity of an under-reamed pile in clay with a neat sketch. (20)

A singly-reamed, 8 m long, RCC pile (as shown in the figure) weighing 20 kN with 350 mm shaft diameter and 750 mm under-ream diameter is installed within stiff, saturated silty clay (undrained shear strength is 50 kPa, adhesion factor is 0.3, and the applicable bearing capacity factor is 9) to counteract the impact of soil swelling on a structure constructed above. Neglecting suction and the contribution of the under-ream to the adhesive shaft capacity, what would be the estimated ultimate tensile capacity (rounded off to the nearest integer value in kN) of the pile?



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. How the tilt and shift can be rectified, if any happened. (5)

(c) Mention the types of caission foundations along with their advantages and disadvantages with neat sketches. (10)

[Turn over

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Part – II

Answer the following questions:
Assume reasonable values of data, if not given.

Q. 1 a) When will you suggest the 'sump pump' method in dewatering system? Differentiate between deep well and well point system of dewatering?
b) Calculate rate of flow - total discharge - time required by a submersible pump of 80% capacity of rate of flow to withdrawn the water of either side excavation in multi-stage well point system including general case as shown in Fig 1. Mention total required time. Design suitable spacing and numbers of well (N_W) in general case only - must consider N_W not greater than 50 – assume, diameter of well 8cm. Design must be for unconfined aquifer in single line slot system. (2+3)+ (10+3)

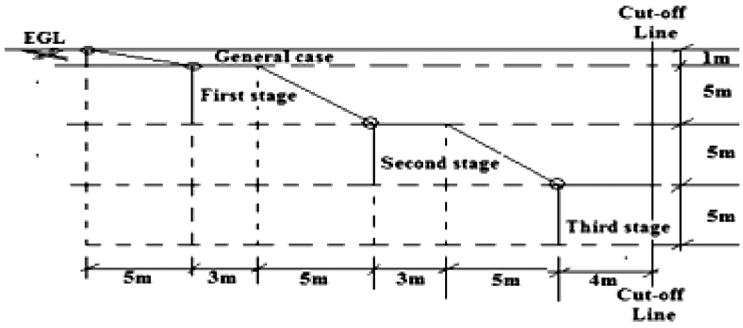

Fig. 1 Multistage Well Point System

Assume, G = 2.65, K = 10^{-2} cm/s and e = 0.69

Q. 2 a) How does earth pressure in 'Braced Cut' differs from that of retaining wall?
b) A site near Kolkata the 10m deep and 4m wide cut is to be made in soft clay of un-drained strength of 2.5 t/m^2 and unit weight of1.80 t/m^3. If the first strut is placed at a depth of 2.0m below ground level and consecutive struts at 3.0 m interval, find out strut loads for a horizontal spacing of 3.0 m. Check also the stability against bottom heave, consider the effect of tension crack and assume N_c is 7.25. 2+(10+3)
Q. 3 a) What is resonance and its effects in machine foundation design? Derive the fundamental expression for amplitude in force vibration system.
b) Check the adequacy of the machine foundation against the problem of resonance in vertical - horizontal direction and amplitude in vertical direction only for table given below. Calculate also the maximum amplitude. Assume, unit weight of concrete is 2.5 ton/m^3 and neglect coupling effect in rocking case. (3+4)+10

Machine Data and its foundation from Manufacturer:				
Element System Marked	Dimensions of Element if Any			Weight (W_i)
(i)	L_{Xi} in meter	L_{Yi} in meter	L_{Zi} in meter	W_i in ton
Compressor	-	-	-	17.9
Motor	-	-	-	8.2
Top Block	4.3	4.8	1.5	?
Bottom Blosk	8.3	4.8	15	?
Speed of compressor 300 r.p.m, unbalanced vertical force 4.2 ton, rotary type machine of permissible amplitude 200 micron.				
Soil Data from Geo-technical Investigator:				
Sandy soil, C_u is 3.0×10^3 ton/m^3, C_r is 1.2×10^3 ton/m^3				

Or, How does machine foundation design is differ from that of general building foundation? Illustrate different types of machine foundation with neat sketches, discuss terminologies used in soil dynamics and general principle of machine foundation design. 1+3+(3+10)