Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem Examination May-2024

CE3CO33 Geotechnical Engineering -II

Programme: B.Tech. Branch/Specialisation: CE

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. Foundations can be broadly classified under _____. **1**

(a) Shallow foundation and deep foundation
(b) Pile foundation
(c) Both (a) and (b)
(d) None of these

ii. Which of the following is a type of shallow footing? **1**

(a) Spread footing (b) Pile foundation
(c) Pier foundation (d) Well foundation

iii. Which of the following piles is used to dense the loose granular soil: **1**

(a) Friction piles (b) End bearing piles
(c) Compaction piles (d) Tension piles

iv. The types of hammer used for driving piles are _____. **1**

(a) Drop hammer (b) Diesel hammer
(c) Vibratory hammer (d) All of these

v. Mechanical stabilisation is: **1**

(a) Addition of cementing material to soils
(b) Addition of limes to soils
(c) Mixing of two or more types of natural soils
(d) Addition of chemicals to soils

vi. Which of the below options sequentially represents the basic principles involved in soil stabilization: **1**

(a) Evaluating property, deciding method, designing mix
(b) Evaluating property, designing mix, considering compaction
(c) Evaluating property, deciding method, designing mix, considering compaction
(d) Evaluating property, considering compaction, deciding method, designing mix

P.T.O.

vii. The general soil exploration gives information about which of the following features: **1**
(a) Depth of rock (b) Composition of soil strata
(c) Ground water level (d) All of these

viii. Wash boring cannot be used for _____ type of soil strata. **1**
(a) Cohesive soil (b) Cohesion less soil
(c) Boulder (d) All of these

ix. Sheet piles are commonly used as _____ in hydraulic structure. **1**
(a) Bulk heads (b) Bearing stratum
(c) Boulders (d) Composite piles

x. The mass-spring system has_____ degree of freedom. **1**
(a) 3 (b) 4 (c) 5 (d) 6

Q.2 i. Explain the various types of foundation with neat sketch. **4**

ii. Discuss the principal modes of soil shear failures in detail. **6**

OR iii. Determine the ultimate bearing capacity of strip footing with 1.5m wide & its base at a depth of 1m, resting on a dry sand stratum. Take density of soil 17 kN/m^3, Angle of internal friction 38°, N_q= 60 & N_y= 75. Use Terzaghi's theory. Also, if factor of safety is 3, determine the safe bearing capacity of soil. **6**

Q.3 i. Express the static formulae for pile load capacity determination of cohesive soil. **4**

ii. Elaborate the design of under-reamed pile foundation for expansive soil. **6**

OR iii. A 200 mm diameter, 8m long piles are used as foundations for a column in a uniform deposit of medium clay (Unconfined Compressive Strength q_u= 100 kN/m^2, Cohesion C_u = 50 kN/m^2). The spacing between the piles is 500 mm. There are 9 piles in the ground arranged in a square pattern. Calculate the ultimate pile load capacity of the group. Assume adhesion factor= 0.9. **6**

Q.4 i. What kind of improvement of the engineering properties of soil mass can be brought about through compaction? **2**

ii. What do you mean by soil stabilisation? Also discuss its need. **3**

iii. Discuss the various functions of Geo-Synthetics material with neat sketch. **5**

OR iv. Explain the mechanical & chemical stabilization of soil in detail. **5**

Q.5 i. List the field test commonly used for soil exploration. **2**

ii. In a site investigation for the design of foundation of a major structure, what kind of detailed information do you set out to obtain? **3**

iii. What is meant by: **5**
(a) Undisturbed sample (b) Disturbed sample
(c) Area ratio (d) Inside clearance
(e) Outside clearance

OR iv. Determine the area ratio for following soil samplers & comment the nature of samples (Undisturbed/ Disturbed) obtained in each of the samples: **5**
(a) Core-Cutter: 165&150 mm Outer & Inner Diameter respectively
(b) Split barrel: 51&35 mm Outer & Inner Diameter respectively
(c) Split Spoon: 51&48 mm Outer & Inner Diameter respectively

Q.6 Attempt any two:

i. What is sheet pile? Classify the sheet piles in terms of material, types & its application. **5**

ii. Define the following terms: **5**
(a) Amplitude (b) Damping
(c) Degree of freedom (d) Forced vibration
(e) Resonance

iii. Discuss the IS design criteria of block foundation. **5**

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Scheme of Marking

Faculty of Engineering
End Sem Examination May-2024
Geotechnical Engineering -II (T) - CE3CO33 (T)
Programme: B.Tech. | Branch/Specialisation:

Q.1	i)	Foundations can be broadly classified under _____ a) Shallow foundation and Deep foundation	**1**
	ii)	Which of the following is a type of shallow footing: a) Spread footing	**1**
	iii)	Which of the following piles is used to dense the loose granular soil: c) Compaction piles	**1**
	iv)	The types of hammer used for driving piles are _____ d) All of the mentioned	**1**
	v)	Mechanical stabilisation is: c) Mixing of two or more types of natural soils	**1**
	vi)	Which of the below options sequentially represents the basic principles involved in soil stabilization: c) Evaluating property, deciding method, designing mix, considering compaction	**1**
	vii)	The general soil exploration gives information about which of the following features: d) All of the mentioned	**1**
	viii)	Wash boring cannot be used for _____ type of soil strata. c) Boulder	**1**
	ix)	Sheet piles are commonly used as _____ in hydraulic structure. a) Bulk heads	**1**
	x)	The mass-spring system has_____ degree of freedom. d) 6	**1**
Q.2	i.	Explain the various types of foundation with neat sketch. Types of foundation: **01 mark each (01*2)** Neat sketch of foundations: **2 marks**	**4**
	ii.	Discuss the principal modes of soil shear failures in detail. Each principal shear failure mode discussion: **02 marks (02*3)**	**6**
	iii.	Determine the ultimate bearing capacity of strip footing with 1.5m wide & its base at a depth of 1m, resting on a dry sand stratum. Take	**6**

		density of soil 17 kN/m^3, Angle of internal friction 38°, N_q= 60 & N_y= 75. Use Terzaghi's theory. Also if factor of safety is 3, determine the safe bearing capacity of soil. For Terzaghi bearing capacity formula:**01 marks**; Determination of ultimate bearing capacity & safe bearing capacity: **2.5 marks each**	
Q.3	i.	Express the static formulae for pile load capacity determination of cohesive soil: Statement: **01 marks** Expression: **03 marks**	**4**
	ii.	Elaborate the design of under-reamed pile foundation for expansive soil: Elaboration: **02 marks** Formula Expression: **03 marks** Neat Sketch: 01 mark	**6**
OR	iii.	A 200 mm diameter, 8m long piles are used as foundations for a column in a uniform deposit of medium clay (Unconfined Compressive Strength q_u= 100 kN/m^2, Cohesion C_u = 50 kN/m^2). The spacing between the piles is 500 mm. There are 9 piles in the ground arranged in a square pattern. Calculate the ultimate pile load capacity of the group. Assume adhesion factor= 0.9. Ultimate pile load capacity of individual pile: **2.5 marks** Ultimate pile load capacity of group pile: **2.5 marks** Finalization of Ultimate pile load capacity above two & comments: **01 mark**	**6**
Q.4	i.	What kind of improvement of the engineering properties of soil mass can be brought about through compaction? Each improvement in engineering properties: **0.5 Mark (0.5*4)**	**2**
	ii.	What do you mean by Soil Stabilisation? Also discuss its need. Soil Stabilization definition: **01 marks** Need: **01 mark**	**3**
	iii.	Discuss the various functions of Geo-Synthetics material with neat sketch.	**5**

		Each Function**: 01 mark (1*5)**	
OR	iv.	Explain the Mechanical & Chemical Stabilization of soil in detail. Mechanical Stabilization: **2.5 marks** Chemical Stabilization: **2.5 marks**	**5**
Q.5	i.	List the field test commonly used for soil exploration. Each field test: **01 Mark (01*2)**	**2**
	ii.	In a site investigation for the design of foundation of a major structure, what kind of detailed information do you set out to obtain? Each investigation details: **01 mark (01*3)**	**3**
	iii.	What is meant by: (a) Undisturbed Sample, (b) Disturbed Sample (c) Area Ratio, (d) Inside Clearance, (e) Outside Clearance For each definitions: **01 mark (01*5)**	**5**
OR	iv.	Determine the area ratio for following soil samplers & comment the nature of samples (Undisturbed/ Disturbed) obtained in each of the samples: (a)Core-Cutter: 165&150 mm Outer & Inner Diameter respectively; (b)Split barrel: 51&35 mm Outer & Inner Diameter respectively, (c)Split Spoon: 51&48 mm Outer & Inner Diameter respectively. Determination of area ratio for each sampler: **01 mark (01*3)** Comment & suitability of best sampler: **02 mark**	**5**
Q.6		Attempt any two:	
	i.	What is sheet pile? Classify the sheet piles in terms of material, types & its application. Definition of sheet pile: **0.5 mark** Classification based on material, types & its application: **1.5 marks each (1.5*3)**	**5**
	ii.	Define the following terms: (a) Amplitude, (b) Damping, (c) Degree of Freedom, (d) Forced vibration, (e) Resonance	**5**

		For each definitions: **01 mark (01*5)**	
	iii.	Discuss the IS design criteria of block foundation. Discussion on design criteria of block foundation :**05 mark**	**5**

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Q2(iii) Terzaghi's bearing capacity equation—

$\phi = 38°$
$C = 0$, Dry sand.

$$q_u = cN_c + qN_q + 0.5B\gamma N_\gamma$$
$$= 0 + \gamma D_f (N_q) + \frac{1}{2}B\gamma N_\gamma$$
$$= (17\times1)\times(60) + \frac{1}{2}\times1.5\times17\times75$$
$$= 1020 + 956.26$$
$$q_{nu} = 1976.25\ kN/m^2$$

Net safe bearing capacity $q_{ns} = \frac{q_{nu}}{FOS} = \frac{1976.25}{3} = 658.75\ kN/m^2$

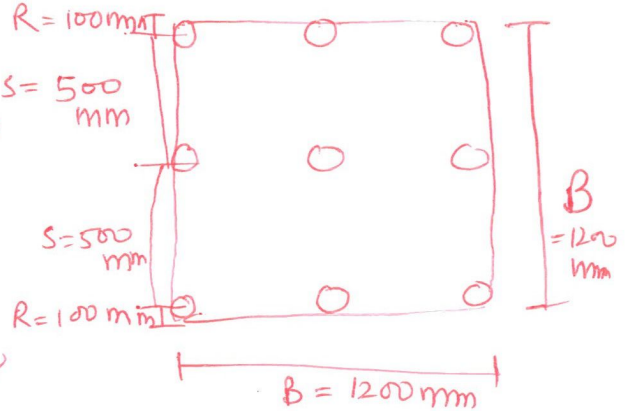
Safe bearing capacity $(q_s) = q_{ns} + \gamma \cdot D_f$
$= 658.75 + (17\times1)$
$= 675.75\ kN/m^2$

Q3(iii) (i) For group —

$q_{ug} = c'N_c \times A_{Pb} + C \times A_{Bb}$

$c' = c = \frac{q_u}{2} = \frac{100}{2}$

$c = 50\ kN/m^2$



For Medium clay

$N_c = 9$

$B = 2S + \frac{d}{2} + \frac{d}{2} = (500\times2) + \frac{100}{2} + \frac{100}{2} = 1200\ mm = 1.2\ m$

P.T.O.

$A_{pb} = B^2 = 1.2 \times 1.2$

$A_{pb} = 1.44\ m^2$

$Q_{ug} = c' N_c \times A_{pb} + C \times A_{sb}$

A_{sb} = Surface area

$A_{sb} = 4BL = 4 \times 1.2 \times 8$

$A_{sb} = 38.4\ m^2$

$Q_{ug} = (50 \times 9) \times 1.44 + 50 \times 38.4$

$= 648 + 1920$

$Q_{ug} = 2568\ KN$

(11) Individual pile

$Q_{ug} = n[C N_c \times A_b + q \times C^x A_s]$

$A_b = \frac{\pi}{4} \times d^2 = \frac{\pi}{4} \times 0.2^2$

$A_b = 0.0314 m^2$

$A_s = \pi d L = \pi \times 0.2 \times 8$

$A_s = 5.024\ m^2$

$Q_{ug} = 9[50 \times 9 \times 0.0314 + 0.9 \times 50 \times 5.024]$

$= 9[14.13 + 226.08]$

$Q_{ug} = 2161.89\ KN$

Final answer will be smaller value amongst TWO.

Selecting $\Rightarrow$ $Q_{ug} = 2161.89 KN$

Allowable load $\rightarrow$

$P_a = \frac{Q_{ug}}{FOS}$

$P_a = \frac{2161.89}{2.5}$

$P_a = 864.756\ KN$