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

Enrollment No.....

Faculty of Engineering

End Sem (Odd) Examination Dec-2018

CE3CO13 Geotechnical Engineering-I

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.

Q.1 i. The relationship between voids ratio e and porosity n is **1**

(a) $n = {e}/{(1-e)}$ (b) e = n(1+e)

(c) $e = {(1+n)}/{(1-e)}$ (d) $n = {(1+e)}/{(1-e)}$

ii. Group symbols assigned to silty sand and clay sand are respectively **1**

(a) SS and CS (b) SM and CS

(c) SM and SC (d) MS and CS

iii. The law that states that for laminar flow in a saturated soil, the velocity is directly proportional to the hydraulic gradient is called **1**

(a) Reynold's law (b) Bligh's law

(c) Darcy's law (d) Lacey's law

iv. The dimensions of coefficient of permeability are **1**

(a) cm (b) g/cm^2 (c) cm/sec (d) g/cm

v. A comparatively sudden reduction in volume of a soil mass under an applied load is called **1**

(a) Primary compression (b) Initial consolidation

(c) Primary time effect (d) Secondary compression

vi. The densification of a soil by machines is called **1**

(a) Consolidation (b) Compression

(c) Compaction (d) Soil stabilisation

vii. Westargaard's analysis for stress distribution beneath loaded area is applicable to **1**

(a) Sandy soil (b) Clayey soil

(c) Stratified soil (d) Silty soil

P.T.O.

viii. The force of attraction between the individual particles of soil which keeps the soil particles bound together is known as **1**
(a) Compaction (b) Cohesion
(c) Friction (d) Dialatancy

ix. A cohesionless soil having an angle of shear resistance Ø is standing at a slope angle of *i*. The factor of safety of slope is **1**
(a) tan*i*/ tanØ (b) tan*i*- tanØ
(c) tanØ/tan*i* (d) tanØ- tan*i*

x. A retaining wall retains a sand strata with Ø= 30° up to its top. If a uniform surcharge of 12 t/m^2 is subsequently put on the sand strata then the increase in the lateral earth pressure intensity on wall will be **1**
(a) 1 t/m^2 (b) 2t/m^2 (c) 4 t/m^2 (d) 8t/m^2

Q.2 i. Work out theoretical maximum dry density for a soil sample having sp. Gr. of 2.7 and OMC = 16%. **3**

ii. The insitu density of an embankment, compacted at a water content of 12% was determined with the help of a core cutter. The empty mass of the cutter was 1286 g and the cutter full of soil had a mass of 3195 g, the volume of the cutter being 1000 cm^3. Determine the bulk density, dry density and the degree of saturation of the embankment. **7**
If the embankment becomes fully saturated during rains, what would be its water content and saturated unit weight? Assume no volume change in soil on saturation. Take the specific gravity of the soil as 2.70.

OR iii. Derive an expression for determination of water content of soil by pycnometer method. **7**

Q.3 i. Define Hygroscopic water, Seepage velocity, Coefficient of permeability and flow net. **4**

ii. Explain quick sand condition and derive an expression for critical hydraulic gradient. **6**

OR iii. Explain factors on which the permeability depends in brief. **6**

Q.4 i. Define Time factor, degree of consolidation and coefficient of volume change. **3**

ii. Explain the facts affecting compaction on soil. **7**

OR iii. Two clay specimen A and B, of thickness 2 cm and 3 cm, have equilibrium voids ratios 0.68 and 0.72 respectively under a pressure of 200 kN/m^2. If the equilibrium voids ratios of the two soils reduced to 0.50 and 0.62 respectively, when the pressure was increased to 400 kN/m^2, find the ratio of the coefficient of permeability of the two specimens. The time required by the specimen A to reach 40% degree of consolidation is ¼ of that required by specimen B for reaching 40% degree of consolidation. **7**

Q.5 i. What do you understand by pressure bulb? **3**

ii. Write brief explanation on Newmark's influence chart with diagram. **7**

OR iii. Explain Mohr – Coulomb failure theory with diagrams. **7**

Q.6 i. A long natural slope of cohesionless soil is inclined at 12° to the horizontal. Taking ø = 30°. Determine the factor of safety of the slope. If the slope is completely submerged, what will be change in the factor of safety? **4**

ii. Write assumptions of coulomb's wedge theory and explain in detail with diagram. **6**

OR iii. Compute the intensities of active and passive earth pressure at depth of 8 m in dry cohesionless sand with an angle of internal friction of 30° and unit weight of 18 kN/m^3 . What will be the intensities of active and passive earth pressure if the water level rises to the ground level? Take saturated unit weight of sand as 22 kN/m^3. **6**

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Marking Scheme
CE3CO13 Geotechnical Engineering-I

Q.1 i. The relationship between voids ratio e and porosity n is **1**
(b) e = n(1+e)

ii. Group symbols assigned to silty sand and clay sand are respectively **1**
(c) SM and SC

iii. The law that states that for laminar flow in a saturated soil, the velocity is directly proportional to the hydraulic gradient is called **1**
(c) Darcy's law

iv. The dimensions of coefficient of permeability are **1**
(c) cm/sec

v. A comparatively sudden reduction in volume of a soil mass under an applied load is called **1**
(b) Initial consolidation

vi. The densification of a soil by machines is called **1**
(c) Compaction

vii. Westargaard's analysis for stress distribution beneath loaded area is applicable to **1**
(c) Stratified soil

viii. The force of attraction nbetween the individual particles of soil which keeps the soil particles bound together is known as **1**
(b) Cohesion

ix. A cohesionless soil having an angle of shear resistance $\emptyset$ is standing at a slope angle of *i*. The factor of safety of slope is **1**
(c) tan$\emptyset$/tan*i*

x. A retaining wall retains a sand strata with $\emptyset$= 30° up to its top. If a uniform surcharge of 12 t/m^2 is subsequently put on the sand strata then the increase in the lateral earth pressure intensity on wall will be **1**
(c) 4 t/m^2

Q.2 i. Theoretical maximum dry density occurs when S = 1 **3**
Hence $\rho_{d,max} = G\rho_w/\{1+(wG/S)\}$
$= G\rho_w/\{1 + wG\}$ 2 marks
$= 1.885$ g/cm^3 1 mark

ii. Mass of soil in cutter M = 1909 g
Bulk density $\rho = M/V = 1.909$ g/cm^3 **7**
Bulk unit weight $\gamma = 9.81\ \rho = 18.73$ kN/m^3
$\gamma_d = \gamma/(1+w) =$ **16.72 kN/m^3**
1 mark
$e = G(\gamma_w/\gamma_d) - 1 = 0.584$
and $S_r = wG/e =$ **0.555** = **55.5%**
2 marks
At saturation, Since the volume remains the same, the voids ratio also remains unchanged,
$w_{sat} = e/G =$ **0.216** = **21.6%**
2 marks
$\gamma_{sat} = \gamma_w(G+e)/(1+e) =$ **20.34 kN/m^3**
2 marks

iii. Expression for determination of water content of soil by pycnometer method **7**
Figure 2 marks
Derivation 5 marks

Q.3 i. Hygroscopic water 1 mark **4**
Seepage velocity 1 mark
Coefficient of permeability 1 mark
Flow net 1 mark

ii. Quick sand condition 2 marks **6**
Derivation - $i_c = (G-1)/(1+e)$ 5 marks

OR iii. Factors on which the permeability depends **6**
Any 6 points 1 mark for each (1 mark * 6)

Q.4 i. Definition Time factor 1 mark **3**
Degree of consolidation 1 mark
Coefficient of volume change 1 mark

ii. Facts affecting compaction on soil. **7**
Water content 1 mark
Amount of compaction 2 marks
Methods of compaction 1 mark
Types of soil 2 marks

		Addition of admixture	1 mark	
OR	iii.	$m_v = \Delta e/\{(1+e_0)\ \Delta\sigma'\}$	1 mark	**7**
		Hence $(m_v)_A = 0.536\ m^2/MN$		
		$(m_v)_B = 0.291\ m^2/MN$		
		$(m_v)_A / (m_v)_B = 1.845$	3 marks	
		$(c_v)_A / (c_v)_B = 16/9$		
		$k_A / k_B = 3.28$	3 marks	
Q.5	i.	Pressure bulb		**3**
		Figure	1 mark	
		Description	2 marks	
	ii.	Newmark's influence chart with diagram		**7**
		Figure	2 marks	
		Description	3 marks	
		Formula	2 marks	
OR	iii.	Mohr – Coulomb failure theory with diagrams		**7**
		Assumptions(3 no)	3 marks	
		Figure	1 mark	
		Formula	1 mark	
		Theory	2 marks	
Q.6	i.	If the slope is completely submerged, what will be change in the factor of safety		**4**
		$F = \tan\phi / \tan i = 2.72$	2 marks	
		Submergence		
		$F = 2.72$	2 marks	
	ii.	Assumptions of coulomb's wedge theory		**6**
		Assumptions	2 marks	
		Diagram	1 mark	
		Explanation	3 marks	
	iii.	Dry soil –		**6**
		$p_a = 48\ kN/m^2$	1.5 marks	
		$p_p = 432\ kN/m^2$	1.5 marks	
		Submerged soil		
		$p_a = 111\ kN/m^2$	1.5 marks	
		$p_p = 371\ kN/m^2$	1.5 marks	

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