PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Sem & AY: Odd Sem.2019-20	**Date:** 30.09.2019
Course Code: CIV 210	**Time:** 2:30PM to 3:30PM
Course Name: GEOTECHNICAL ENGINEERING	**Max Marks:** 40
Program & Sem: B.Tech (CIV) & V	**Weightage:** 20%

Instructions:

(i) Use Semi-log graph sheet for plotting data.
(ii) Question paper consists of 3 parts.
(iii) Scientific and Non-programmable calculators are permitted.

Part A (Memory Recall Questions)

Answer all the Questions. Each Question carries three marks. (4Qx3M=12M)

1. Define void ratio, saturated density and activity of clay (C.O.NO.1) [Knowledge]

2. List the index properties of soil. (C.O.NO.1) [Knowledge]

3. Match the following according to particle size classification:

List A- Type of soil particle	List B- Maximum particle size
i) Sand	a) 0.075 mm
ii) Clay size	b) 4.75 mm
iii) Silt size	c) 0.002 mm

(C.O.NO.1) [Knowledge]

4. Describe any one soil deposit in India. (C.O.NO.1) [Knowledge]

Part B (Thought Provoking Questions)

Answer all the Questions. Each Question carries four marks. (3Qx4M=12M)

5. Derive the relationship between dry density, void ratio, specific gravity and density of water. (C.O.NO.1) [Comprehension]
6. Name any one clay mineral with brief note. (C.O.NO.1) [Knowledge]
7. Explain any two soil structure with neat sketch. (C.O.NO.1) [Comprehension]

Part C (Problem Solving Questions)

Answer both the Questions. Each Question carries eight marks. (2Qx8M=16M)

8. A clayey soil was tested for liquid limit and the following were the results. Plastic limit was found to be 28% and natural water content was 35%. Find consistency index and liquidity index.

Number of blows	34	23	18	12
Water Content	44.6	49.4	51.4	55.6

(C.O.NO.1) [Comprehension]

9. A soil sample is found to have the following properties.
   Passing 75 µ sieve = 4%
   Passing 4.75 mm sieve = 80%
   Coefficient of uniformity (C_u) = 7.5
   Coefficient of curvature (C_c) = 2.8
   Classify the soil according to I.S. classification system.

(C.O.NO.1) [Comprehension]

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: 5th

Course Code: CIV210

Course Name: Geotechnical Engineering

Date: 30th September 2019

Time: 2:30 PM TO 3:30 PM

Max Marks: 40

Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O. NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
		Introduction to Geotechnical engineering	K	K & C	C	
1	1	1	3	-	-	3
2	1	1	3	-	-	3
3	1	1	3	-	-	3
4	1	1	3	-	-	3
5	1	1	-	4	-	4
6	1	1	4	-	-	4
7	1	1		4		4
8	1	1	-	-	8	8
9	1	1	-	-	8	8
10	1	1	-	-	8 (Choice)	8

	Total Marks		16	8	16	40

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I here certify that All the questions are set as per the above lines Jagdish]

Annexure- II: Format of Answer Scheme

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

SOLUTION

Date: 30th September 2019

Time: 2:30 PM TO 3:30 PM

Max Marks: 40

Weightage: 20%

Semester: 5th

Course Code: CIV210

Course Name: Geotechnical Engineering

Part A (4Q x 3M = 12 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	Void ratio I – It is the ratio of the volume of voids to the volume of the solids $$e = \frac{V_v}{V_s}$$ Saturated mass density (ρ_{sat}) – It is the bulk mass density of the soil when it is fully saturated.	Each definition carries 1 mark	**4 min**

	$\rho_{sat} = \frac{M_{sat}}{V}$ Activity Of Clay Activity (A) of a soil is the ratio of the plasticity index and the percentage of clay fraction (less than 2μ size). $\mathbf{A = I_p / F}$ Where I_p = plasticity index, F = clay fraction. The clay fraction F is percentage finer than 2μ size.		
2	Water content, specific gravity, in-situ density, relative density, particle size distribution curve, consistency limts	Each name carries 1 mark	**3 min**
3	**i) – b** **ii) – c** **iii) -- a**	Each matching carries 1 mark	**3 min**
4	The soil deposits of India may be classified in the following five major groups: **Alluvial Soils** Alluvial soils are by far the largest and the most important soil group of India. A large part of north India is covered with alluvial deposits. The deposits are generally of low density and are liable to liquefaction in earthquake-prone areas. **Black Cotton Soils** A large part of central India and a portion of South India is covered with black cotton soils. These are residual deposits formed from basalt or trap rocks. These are suitable for growing cotton. These are clays of high plasticity- high shrinkage and swelling characteristics- low shearing strength- high compressibility.	Any one carries 3 mark	**5 min**

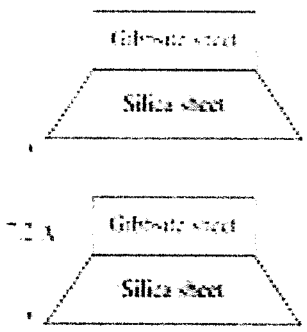
	Lateritic Soils Formed by decomposition of rock, removal of bases and silica, and accumulation of iron oxide and aluminium oxide. Presence of iron oxide gives these soils the characteristic red or pink colour. Lateritic soils exist in the central, southern and eastern India. **Desert Soils** A large part of Rajasthan and adjoining states is covered with sand dunes. Dune sand is uniform in gradation. The size of the particles is in the range of fine sand. Sand is non-plastic and highly pervious. **Marine Deposits** These are mainly confined along a narrow belt near the coast. In the south-west coast of India, there are thick layers of sand above deep deposits of soft marine clays. The marine deposits have very low shearing strength and are highly compressible.		

Part B (3Q x 4M = 12 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
5	**SCOPE OF SOIL ENGINEERING** - Vast application in the construction of various civil engineering works. **(i)** Foundations- Foundation Engineering is an important branch of soil engineering **(ii)** Retaining structures – Soil engineering gives theories of earth pressure on retaining structures	Any two carries 4 mark	5 min

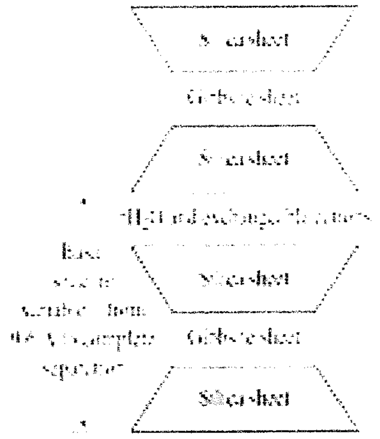
<table>
<tr><td></td><td>(iii) Stability of slopes- Soil engineering provides methods for checking stability of slopes
(iv) Underground structures – the forces exerted by soil are discussed in soil engineering.
(v) Pavement design – behavior of subgrade under various loading is studied.</td><td></td><td></td></tr>
<tr><td>6</td><td>1. Kaolinite
It is most common mineral. Basic structural unit consists of alumina sheet (gibbsite) combined with silica sheet. The kaolinite mineral is formed by stacking, one over the other and several such basic units. The bonding between layers are hydrogen bonds (strong bonding). Thickness 7.2 Å

It is the main constituent of china clay.


Kaolinite

2. Montmorillonite

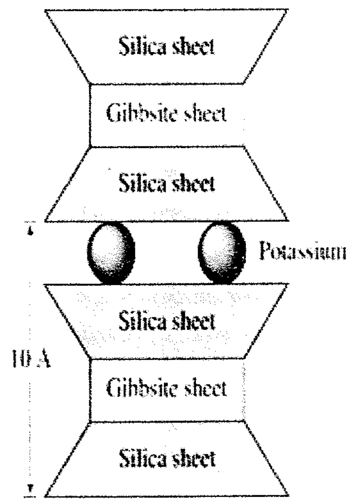
It is also most common mineral. Basic structural unit consists of alumina sheet (gibbsite) sandwiched between two silica sheets. Thickness – 10 Å. The n·H_2O and cations exist between unit layers. The interlayer bonding is by van der Waals forces and by cations which balance charge deficiencies (weak bonding). Primary constituent of black cotton soil, bentonite clay and other expansive clays. The soil containing a large amount of the mineral montmorillonite exhibits high shrinkage and high swelling characteristics.</td><td>Any one carries 4 mark</td><td>5 min</td></tr>
</table>



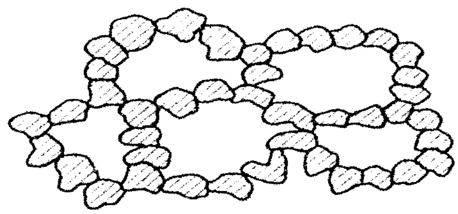
Montmorillonite

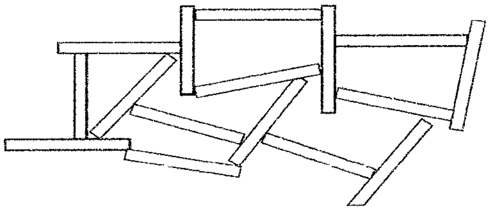
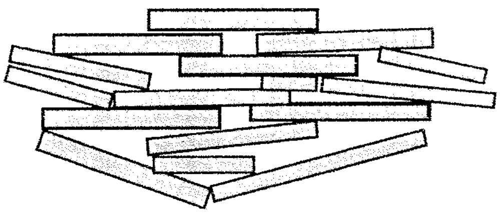
3. Illite

The basic structure is very similar to montmorillonite. Isomorphous substitution of aluminium for silicon in the silica sheet and the resulting charge deficiency is balanced by potassium ions which bond the layers in the stack. The bond with non-exchangeable K+ ions are weaker than hydrogen bond of kaolinite but is stronger than the water bond of montmorillonite.



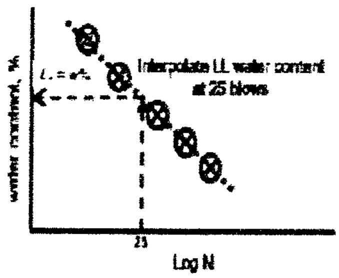
Illite

7	**1. Single Grained Structure** It is found in the case of coarse grained soil deposits. The particles settle independently of each other in water. The major force causing their deposition is gravitational and surface forces are too small to produce any effect. There will be particle-to-particle contact in the deposit. The void ratio attained depends on the relative size of grains.  **2. Honeycomb Structure** It is associated with fine sands, silt deposits. The silt particles settle out of suspension, in addition to gravitational forces the surface forces also play a significant role. When particles approach the lower region of suspension they will be attracted by particles deposited as well as the neighboring particles leading to the formation of arches. The combination of a number of arches leads to the honeycomb structure. Particles are held in position due to cohesion (small)As the deposit has high void ratio, when disturbed as in pile driving, there will be large reduction in volume due to breakdown of structure.  **3. Flocculated Structure** clay particles have a –ve charge on the surface and a +ve charge on the edges. In the case of flocculated structure there will be *edge to face* contact between the particles. The concentration of dissolved minerals in water leads to formation of flocculated structure with very high void ratio as in the case of marine deposits.	Any two carries 4 mark	5 min

	 **4. Dispersed Structure** In the case of dispersed or oriented structure, the particles will have face to face contact (more or less a parallel orientation).This type of structure is common in fresh water deposits. Clay with flocculated structure will have relatively high void ratio. Remoulding of such soils or application of pressure as in compaction leads to slippage of particles resulting in dispersed structure with decrease in void ratio. Consolidation also tends to reorient the particles to form dispersed structure with decrease in volume. 		

Part C (2Q x 8M = 16 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question

8	$w = \frac{M_w}{M_d} = \frac{30}{160} = 0.188 = 18.8\ \%$ Mass of moist soil = M = 190 g ∴ Bulk density $\rho = \frac{M}{V} = \frac{190}{100} = 1.9\ g/cm^3$ Hence $\gamma = 9.81 \times \rho = 9.81 \times 1.9 = 18.64\ kN/m^3$ Alternatively, $\gamma = \frac{W}{V} = \frac{190\ (g)}{100\ (cm^3)} \times 9.81 = 18.64\ kN/m^3$ (Since $1\ g/cm^3 = 9.81\ kN/m^3$) ∴ $\gamma_d = \frac{\gamma}{1+w} = \frac{18.64}{1+0.188} = 15.69\ kN/m^3$ Alternatively, $\gamma_d = \frac{W_d}{V} = \frac{160}{100} \times 9.81 = 15.69\ kN/m^3$ $e = \frac{G\gamma_w}{\gamma_d} - 1 = \frac{2.68 \times 9.81}{15.69} - 1 = 0.67$ Porosity = 40.11 percent $S = \frac{wG}{e} = \frac{0.188 \times 2.68}{0.67} = 0.744 = 74.4\ \%$	w = 2 marks e = 2 marks S = 2 marks ŋ = 2 marks	8 min
9	$\omega = 35\%$ $\omega_P = 28\%$ $\omega_L = 48.5\%$ $I_L = 0.34$ $I_C = 0.66$  $I_L = \frac{\omega - \omega_P}{I_P}$ $I_C = \frac{\omega_L - \omega}{I_P}$	LL = 4 marks LI = 2 marks CI = 2 marks	8 min

10	Since more than 50% is retained on 75 μ sieve the soil is coarse- grained. Since more than 50% passes through 4.75 mm sieve , the soil is sandy (S). Further, $C_u > 6$ and C_c lies between 1 and 3. Therefore it is well graded. ∴ Soil classification is SW.	Coarse grained = 2 marks Sand = 2 marks Well graded = 2 marks Soil type = 1 mark Symbol = 1 mark	8 min

Roll No.													

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU
SCHOOL OF ENGINEERING

TEST – I

Semester: 5th
Course Code: EEE210
Course Name: **Electrical Machines-II**

Date: 27.09.2019
Time: 2.30 to 3.30 PM
Max Marks: 40
Weightage: 20%

Instructions:

i. *Read the question properly and answer accordingly.*
ii. *Question paper consists of 3 parts.*
iii. Scientific and Non-programmable calculators are permitted

---

Part A

Answer all the Questions. Each question carries three marks. (3Qx4M=12)

1. Differentiate between ideal transformers and practical transformers. (C.O.NO: 1) [Bloom's level: 1]
2. Draw the no-load phasor diagram of a transformer and derive expressions for magnetizing and core-loss components of no-load current. (C.O.NO: 1), [Bloom's level: 1]
3. Explain why iron losses are constant from no load to full load. (C.O.NO: 1), [Bloom's level: 1]

Part B

Answer all the Questions. Each question carries eight marks. (2Qx8M=16)

4. The maximum flux density in the core of 250/3000V,50Hz single phase tris 1.2 wb/m2.if the emf/turn is 8v , determine 1)primary and secondary turns (C.O.NO: 1) [Bloom's level:2]

5. Justify your answer
i). Is the efficiency of a transformer same at 0.8 pf lag and 0.8 pf lead when connected to the same load.
ii) Which test gives the copper losses of a single phase transformer?
(C.O.NO: 2) [Bloom's level: 2]

Part C

Answer the Question. (1Qx12M=12)

6. Consider a 4 KVA, 200/400V single phase transformer supplying full load current at 0.8 pf. The OC test results are as follows. OC test: 200V, .8A, 70 W - LV side; SC test 20V, 10A, 60W - HV side. Calculate the efficiency of the given transformer. (C.O.NO: 2) [Bloom's level:2].

Roll No.												

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU
SCHOOL OF ENGINEERING

TEST – I

Semester: 5th
Course Code: EEE210
Course Name: **Electrical Machines-II**

Date: 27.09.2019
Time: 2.30 to 3.30 PM
Max Marks: 40
Weightage: 20%

Instructions:

i. Read the question properly and answer accordingly.
ii. *Question paper consists of 3 parts.*
iii. Scientific and Non-programmable calculators are permitted

---

Part A

Answer all the Questions. Each question carries four marks. (2Qx5M=10)

1. Differentiate between step up and step down transformers.(C.O.NO. 1) [Bloom's level: 1]
2 .Draw the complete phasor diagram for a transformer when the load pf is lagging. (C.O.NO. 2), [Bloom's level: 2]

Part B

Answer all the Questions. Each question carries six marks. (3Qx6M=18)

3. Draw the approximate equivalent circuit of a transformer referred to the primary side and indicate how it differs from the exact equivalent circuit. (C.O.NO. 2) [Bloom's level:2]

4. What are the different losses in a transformer? Which loss is considered to be constant from no load to full load ? Explain with reason. (C.O.NO. 1) [Bloom's level: 1]

5. What happens when the primary terminals of a single phase transformer are connected to rated supply while secondary terminals are short circuited. (C.O.NO. 2) [Bloom's level 1]

Part C

Answer the Question. (1Qx12M=12)

6. Consider a 4 KVA, 200/400V single phase transformer supplying full load current at 0.8 pf. The OC test results are as follows. OC test: 200V, .8A, 70 W - LV side; SC test 20V, 10A, 60W - HV side. Calculate the efficiency of the given transformer. (C.O.NO. 2) [Bloom's level 2:].

Roll No.													

PRESIDENCY UNIVERSITY

BENGALURU

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

TEST- 2

Sem & & AY: Odd Sem 2019-20 | **Date**: 18.11.2019

Course Code: CIV 210 | **Time**: 2.30 PM to 3.30 PM

Course Name: GEOTECHNICAL ENGINEERING | **Max Marks**: 40

Program & Sem: B.Tech. (CIVIL) &V Sem | **Weightage**: 20%

Instructions:

(i) *Read the questions correctly and answer the questions to the point*

(ii) *Only scientific calculators are allowed*

(iii) *Answer all the question from part A, part B and part C.*

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries three marks. (4Qx3M=12M)

1. State Darcy's law and explain the validity of Darcy's law. (C.O.NO.2)[Knowledge]
2. Derive the expression for maximum capillary rise. (C.O.NO.2)[Knowledge]
3. Differentiate between discharge velocity and seepage velocity. (C.O.NO.2)[Knowledge]
4. List the properties of flow nets. (C.O.NO.2)[Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each question carries four marks. (3Qx4M=12M)

5. Find the average horizontal and vertical permeability of a soil mass made up of three horizontal layers. The first and second layer have same thickness of 60 cm each and third layer is 80 cm thick. The coefficient of permeability of first, second and third layer are 2×10^{-4} cm/s, 2.5×10^{-5} cm/s and 1.2×10^{-4} cm/s respectively. (C.O.NO.2)[Comprehension]
6. Briefly explain the factors affecting coefficient of permeability. (C.O.NO.2)[Knowledge]
7. In a falling head permeability test, the water level in the stand pipe dropped from 400 mm to 200 mm in 60 minutes. The diameter of the sample and stand pipe were 80 mm and 5 mm respectively, while the length of the sample was 95 mm. Determine the coefficient of permeability of soil. (C.O.NO.2)[Comprehension]

Part C [Problem Solving Questions]

Answer both the Questions. Each question carries eight marks. (2Qx8M=16M)

8. Calculate and plot the total stress, pore water pressure and effective stress diagram for the soil profile shown in Fig. 1. (C.O.NO.2)[Comprehension]

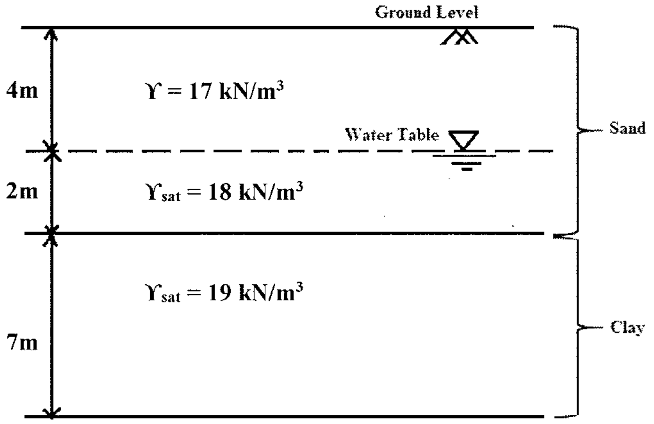


Fig. 1

9. Calculate the coefficient of permeability of a soil sample 6cm in height and 50 cm^2 in cross sectional area, if a quantity of water equal to 430 cc passed down in 10 minutes under an effective constant head of 40 cm. On oven drying, the test specimen weighed 4.98 N. Also, determine the seepage velocity during the test. Take G = 2.65. (C.O.NO.2)[Comprehension]

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: 5th

Course Code: CIV210

Course Name: Geotechnical Engineering

Date: 18/11/19

Time: 2:30 PM TO 3:30 PM

Max Marks: 40

Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O. NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	K & C	C	
1	2	2	3	-	-	3
2	2	2	3	-	-	3
3	2	2	3	-	-	3
4	2	2	3	-	-	3
5	2	2	-	4	-	4
6	2	2	4	-	-	4
7	2	2		4		4
8	2	2	-	-	8	8
9	2	2	-	-	8	8
	Total Marks		16	8	16	40

K =Knowledge Level   C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

Annexure- II: Format of Answer Scheme

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

SOLUTION

Semester: 5^{th}

Course Code: CIV210

Course Name: Geotechnical Engineering

Date: 18/11/19

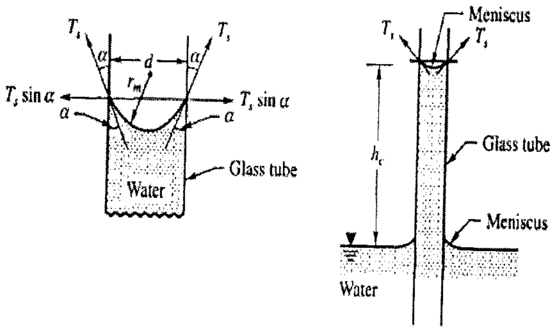
Time: 2:30 PM TO 3:30 PM

Max Marks: 40

Weightage: 20%

Part A (4Q x 3M = 12 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	For laminar flow through saturated soil mass, the velocity of flow is directly proportional to the hydraulic gradient". or ($v \propto i$) v = k.i .... Darcy's Law Where, i = Hydraulic gradient = h/L k = coefficient of Permeability v = Velocity of flow (discharge velocity) 1. Darcy's law is valid if the flow through soils is laminar : The flow of water through soils depends upon the dimension of particles. In fine grained soils, the dimensions of the interstices (voids) are very small and flow is necessarily laminar.	1M 2M	**4 min**

	In coarse- grained soil, the flow is also laminar. However, in very coarse grained soils, such as gravels, the flow may be turbulent. For flow through soils, the flow is laminar if the Reynolds number is less than unity. 2. As per Allen Hazen, the maximum diameter of the particle for the flow to be laminar is about 0.50 mm. 3. It is valid for flow in clays, silts and fine sands. In coarse sands, gravels and boulders, the flow may be turbulent and Darcy's law may not be applicable. 4.For Darcy's law to be valid, the relationship between velocity (v) and hydraulic gradient (i) should be linear. 5. In extremely fine-grained soils, such as collodial clay, the interstices are very small. The velocity is therefore very small. In such soils, the Darcy's law is not valid.		
2	Using vertical equilibrium $\pi d T_s \cos\alpha = \frac{\pi d^2 h_c \gamma_w}{4}$ or $h_c = \frac{4T_s \cos\alpha}{d\gamma_w}$  	3M	**3 min**
3	**Discharge Velocity & Seepage Velocity** Discharge Velocity: * It is also called as Theoretical velocity * The Total cross section of area of soil considered (A) * Proportionality constant is Coefficient of permeability ($v \propto i \Rightarrow v = ki$) * Discharge velocity value less than seepage velocity Seepage Velocity: * It is also called as actual or true velocity * Only cross sectional area of voids considered (Av) * Proportionality constant is Coefficient of Percolation (kp) ($V_s \propto i \Rightarrow V_s = k_p i$) * seepage velocity value more than discharge velocity	3M	**3 min**

4	**Properties of a Flow Net** The properties of a flow net can be expressed as given below: 1. Flow and equipotential lines are smooth curves. 2. Flow lines and equipotential lines meet at right angles to each other. 3. No two flow lines cross each other. 4. No two flow or equipotential lines start from the same point.	3M	**5 min**

Part B

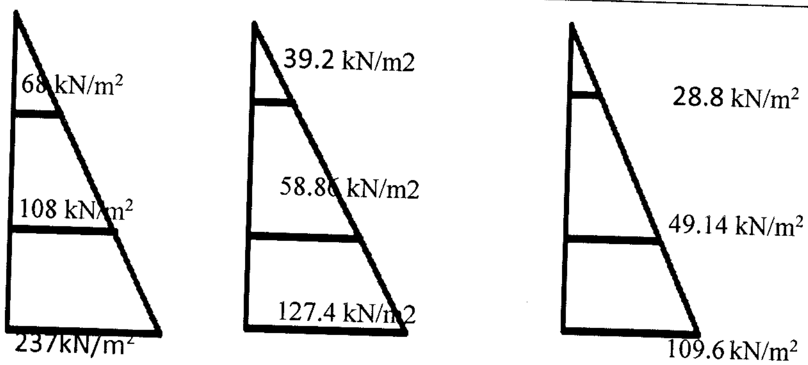
(3Q x 4M = 12 Marks)

Q No	**Solution**	**Scheme of Marking**	**Max. Time required for each Question**
5	k_h= 0.0231/200 = 1.155 * 10^-4 cm/s kv = 5.94*10^-5 cm/s	2M 2M	5 min
6	Factors affecting the permeability of soils are 1. Particle size. 2. Properties of pore fluid. 3. Void ratio of soil. 4. Shape of particles. 5. Structure of soil mass. 6. Degree of saturation. 7. Adsorbed water. 8. Impurities in water. 1. Particle size: Permeability varies approximately as the square of the grain size. (Allen hazen's formula). 2. Properties of pore fluid :The Permeability of the soil varies directly with unit weight & inversely proportional to the viscosity of the water $k \propto \gamma w/\mu$ 3. Void ratio of soil: The coefficient of permeability varies as e^3 / (1+e). For a given soil, greater the void ratio, the higher is the value of the coefficient of permeability. 4. Shape of soil particles: Permeability of a soil depends upon the shape of particles. - Angular particles have greater specific surface area as compared with rounded particles. For the same void ratio, soils with angular particles have lesser permeability as compared with the rounded particles. (k α 1/SSA) 5) Structure of soil mass :Stratified soil deposits have greater permeability parallel to the plane of stratification than that perpendicular to this plane. -	4M for any 4 points	5 min

	For the same void ratio the permeability is more in case of flocculated structure as compared to that in the dispersed structure. 6.Degree of saturation : If the soil is not fully saturated it contains air pockets formed due to entrapped air. The permeability of partially saturated soil is considerably smaller than that of fully saturated soil. 7. Adsorbed water :The fine grained soils have a layer of adsorbed water strongly attached to their surface. This adsorbed water layer is not free to move under gravity. It cause an obstruction to flow of water in the pores and hence reduces the permeability of soils. 8. Impurities in water : Any foreign matter in water has a tendency to plug the flow passage and reduce the permeability of soil.		
7	Use Eq. $k = \frac{2.3aL}{A(t_1 - t_0)} \log \frac{h_0}{h_1}$ k = 7.144 * 10^-5 mm/s	4M	5 min

Part C (2Q x 8M = 16 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
8	k = 0.0215mm/s v = k.i = 0.143mm/s Υ_d = 16.6 kN/m^3 e = 0.57 n = 0.36 v_s = 0.397 mm/s	k = 2 marks e = 2 marks n = 2 marks v_s = 2 marks	8 min

9	68 kN/m2 108 kN/m2 237kN/m2 39.2 kN/m2 58.86 kN/m2 127.4 kN/m2 28.8 kN/m2 49.14 kN/m2 109.6 kN/m2	8M	8 min

Roll No												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 20 | **Date**: 26 December 2019

Course Code: CIV 210 | **Time**: 9.30 AM to12.30 PM

Course Name: GEOTECHNICAL ENGINEERING | **Max Marks**: 80

Program & Sem: B.Tech.(CIV) & V | **Weightage**: 40%

Instructions:

(i) Read the all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and Non – programmable calculators are allowed.
(iv) Use 2 normal graph sheets for plotting data.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 5 marks. (4Qx5M=20M)

1. Explain well graded, uniformly graded and gap graded soils with the help of a neat sketch. (C.O.No.1) [Knowledge]

2. State Darcy's law and differentiate seepage and discharge velocity. (C.O.No.2) [Knowledge]

3. Define shear strength of soil and state the advantages and disadvantages of direct shear test. (C.O.No.3) [Knowledge]

4. List the factors affecting compaction and explain any two factors. (C.O.No.4) [Knowledge]

Part B [Thought Provoking Questions]

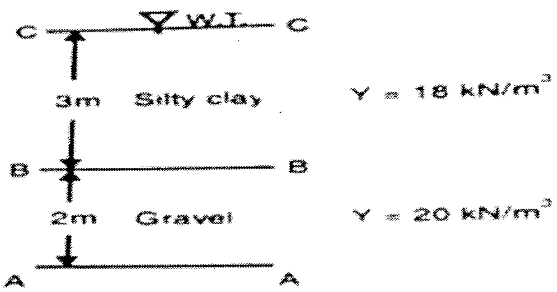
Answer all the Questions. Each Question carries 10 marks. (3Qx10M=30M)

5. i) A soil sample has a porosity of 40% and water content of 12.4%. The specific gravity of solids is 2.7. Calculate the voids ratio, dry unit weight. Unit weight if the soil is 50% saturated and unit weight if the soil is completely saturated.

   ii) Compute density index if specific gravity of sand particles is 2.67 and the in-situ percentage voids of a sand deposit is 34%. For determining density index, dried stratum was filled loosely in 1000cc mould and was then vibrated to give a maximum density. The loose dry mass in the mould was 1610g and dense dry mass at maximum compaction was found to be 1980g. (C.O.No.1) [Comprehension]

6.i) Calculate the coefficient of permeability of a soil sample 5 cm in height and 40 cm^2 in cross sectional area if the discharge is 450 cc is passed down in 10 minutes under an effective constant head of 40 cm. On oven drying the test specimen weighed 4.5 N. Taking G=2.65, calculate the seepage velocity of water. (C.O.No.2) [Comprehension]

ii) Draw the variation of total stress diagram for the subsoil condition given below.



7. i) List the difference between compaction and consolidation [5M]

(C.O.No.4) [Comprehension]

ii) Draw the Coulomb envelope for pure cohesive soil, cohesionless soil and for the soil having both cohesion and frictional properties. State Mohr Coulomb equation [5M]

(C.O.No.3) [Comprehension]

Part C [Problem Solving Questions]

Answer all the Questions. Each Question carries 10 marks. (3Qx10M=30M)

8. Un-drained tri-axial tests are carried out on four identical specimens of silty clay and the following results are obtained. Determine the effective angle of shearing resistance by plotting failure envelope. (C.O.No.3) [Application]

Cell pressure (kN/m^2)	50	100	150	200
Deviator stress at failure (kN/m^2)	350	440	530	610
Pore pressure (kN/m^2)	5	10	12	18

9. Following are the results of a compaction test

Mass of mould+wet soil (g)	2925	3095	3150	3125	3070
Water content (%)	10	12	14.3	16.1	18.2

Volume of the mould= 1000cc. Specific gravity of solids=2.7. Draw the compaction curve showing the optimum moisture content and maximum dry density and also plot zero air voids line.

(C.O.No.4) [Application]

10. Explain over consolidated, normally consolidated and under consolidated soils and also explain the consolidation process by mass spring analogy. (C.O.No.4) [Application]

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE REACH GREATER HEIGHT

END TERM FINAL EXAMINATION

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO (% age of CO)	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	A	
1	1	1	5	-	-	5
2	2	2	5	-	-	5
3	3	3	5	-	-	5
4	4	4	5	-	-	5
5	1	1	-	10	-	10
6	2	2	-	10	-	10
7 i)	4	4	-	5	-	5
7 ii)	3	3		5		5
8	3	3	-	-	10	10
9	4	4	-	-	10	10
10	4	4	-	-	10	10
	Total Marks		20	30	30	80

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%.

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines.

Faculty Signature:

Reviewer Commend:

Format of Answer Scheme

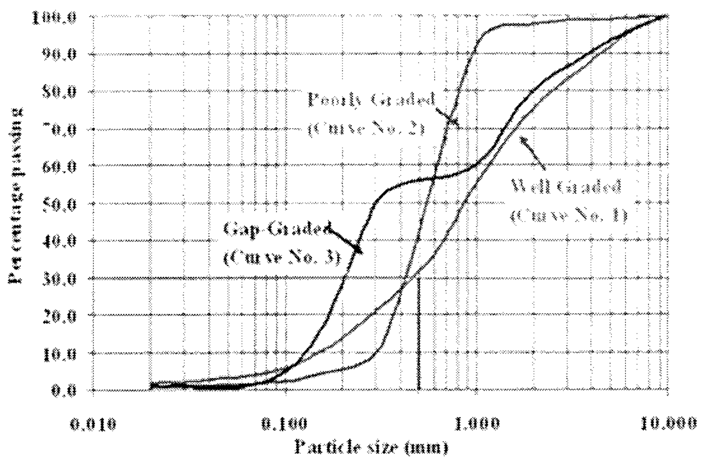
SCHOOL OF ENGINEERING

SOLUTION

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester:	Odd Sem. 2019-20	**Date**:	26.12.2019
Course Code:	CIV 210	**Time**:	3 HRS
Course Name:	GEOTECHNICAL ENGINEERING	**Max Marks**:	80
Program & Sem:	B.Tech and 7th	**Weightage**:	40%

Part A (4Q x 5M =20Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Questior
1	 A flat S-curve, such as curve B, represents a soil which contains the particles of different sizes in good proportion. Such a soil is called a well-graded (or uniformly graded) soil. A steep curve, like C, indicates a soil containing the particles of almost the same size. Such soils are known as uniformly graded soils A curve with a hump, such as curve A, represents the soil in which some of the intermediate particles are missing. Such a soil is called gap-graded or skip graded.	**Diagram 1 marks, definitions each 2 marks**	**11**
2	The Darcy's law is, "For laminar flow through saturated soil mass, the discharge per unit time is proportional to the hydraulic gradient". ($q \propto i$) or ($v \propto i$) $q = k.i.A$ q = Discharge per unit time (rate of flow), A = Total c/s area of soil mass, i = Hydraulic gradient = h/L, k = Darcy's coefficient of Permeability	**1+2+2**	**11**

	Discharge Velocity vs **Seepage Velocity** Discharge Velocity: * It is also called as theoretical velocity * The total cross section of area of soil considered (A) * Proportionality constant is coefficient of permeability ($v \propto i \Rightarrow v = ki$) * Discharge velocity value less than seepage velocity Seepage Velocity: * It is also called as actual or true velocity * Only cross sectional area of voids considered (A_v) * Proportionality constant is coefficient of Percolation (k_p) ($V_s \propto i \Rightarrow V_s = k_p i$) * Seepage velocity value more than discharge velocity		
3	The shear strength of a soil mass is the internal resistance per unit area that the soil mass can offer to resist failure and sliding along any plane inside it. In other words shear strength of a soil is its maximum resistance to shear stresses just before the failure. **ADVANTAGES** Easiest and quickest test. Large samples may be tested in large shear boxes. Small samples may give misleading results due to imperfections (fractures and fissures) or the lack of them. Samples **may be sheared along predetermined planes**. This is **useful when the shear strengths along fissures or other selected planes are required.** **DISADVANTAGES** The shear failure is forced to occur along or across a predetermined plane which is not necessarily the weakest plane of the soil specimen tested Non-uniform deformations and stresses in the specimen. The stress-strain behavior cannot be determined. The estimated stresses may not be those acting on the shear plane	**1+2+2**	**11**
4	**Factors affecting compaction**: Water content, Amount of compaction, Types of soil, Methods of soil compaction and admixtures Water Content: At low water content, the soil is stiff and offers more resistance to compaction. As the water content is increased, the soil particles get lubricated. The soil mass becomes more workable and the particles have closer packing. The dry density of the soil increases with an increase in the water content till the optimum water content in reached. At that stage, the air voids attain approximately a constant volume. With further increase in water content, the air voids do not decrease, but the total voids (air plus water) increase and the dry density decreases. At low water content, the soil is stiff and offers more resistance to compaction. As the water content is increased, the soil particles get lubricated. The soil mass becomes more workable and the particles have closer packing. The dry density of the soil increases with an increase in the water content till the optimum water content in	**1+2+2**	**11**

	reached. At that stage, the air voids attain approximately a constant volume. With further increase in water content, the air voids do not decrease, but the total voids (air plus water) increase and the dry density decreases. **Amount of Compaction** The compaction of soil increases with the increase in amount of compactive effort. With increase in compactive effort, the optimum water content required for compaction also decreases. At a water content less than the optimum, the effect of increased compaction is more predominant. At a water content more than the optimum, the volume of air voids become almost constant and the effect of increased compaction on soil is not significant. **Type of Soil:** The compaction of soil depends upon the type of soil. In general, coarse grained soils can be compacted to higher dry density than fine-grained soils. With the addition of even a small quantity of fines to a coarse-grained soil, the soils attain a much higher dry density for the same compactive effort. However, if the quantity of the fines in increased to a value more than that required to fill the voids of the coarse-grained soils, the maximum dry density decreases. A well graded sand attains a much higher dry density than a poorly graded soil. **Method of Soil Compaction:** The dry density achieved depends not only upon the amount of compactive effort but also on the method of compaction. For the same amount of compactive effort, the dry density will depend upon whether the method of compaction utilizes kneading action, dynamic action or static action **Admixtures:** Compaction characteristics are altered with the addition of various admixtures such as lime, flyash etc.		

Part B (3Q x 10M =30 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
5	(a) We have $e = \frac{n}{1-n} = \frac{0.4}{1-0.4} = 0.667$ (b) $\gamma_d = \frac{G\gamma_w}{1+e} = \frac{2.7 \times 9.81}{1+0.667} = 15.89$ kN/m^3 (Taking $\gamma_w = 9.81$ kN/m^3) (c) $e = \frac{wG}{S}$ or $w = \frac{eS}{G} = \frac{0.667 \times 0.5}{2.70} = 0.124$ $\gamma_d = 15.89$ kN/m^3 (as before) $\therefore$ $\gamma = \gamma_d(1+w) = 15.89 \times 1.124 = 17.85$ kN/m^3	5+5	22

<table>
<tr><td></td><td>ii) e=0.515, γ_d =17.3kN/m^3, γ_{dmax}= 19.423kN/m^3, γ_{dmin}=15.79 kN/m^3, e min=0.35, e max=0.659 and ID=46.5%</td><td></td><td></td></tr>
<tr><td>6</td><td>

i)

$Q = 430$ ml ; $t = 10 \times 60 = 600$ seconds

$A = 50$ cm^2 ; $L = 6$ cm ; $h = 40$ cm

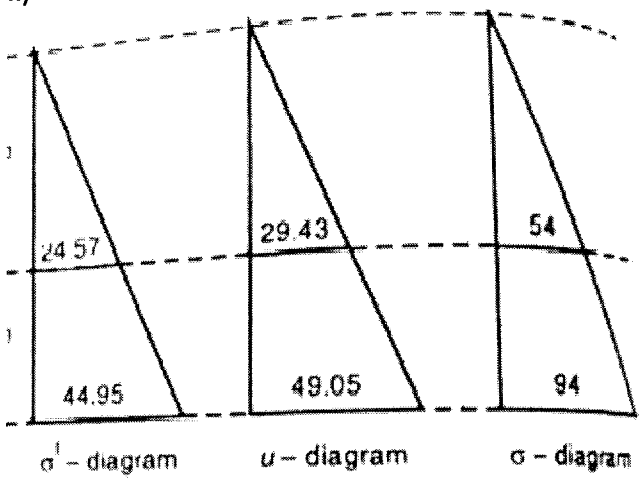
$$k = \frac{Q}{t} \frac{L}{h} \frac{1}{A} = \frac{430}{600} \times \frac{6}{40} \times \frac{1}{50} = 2.15 \times 10^{-3} \text{ cm/sec}$$

$= 2.15 \times 10^{-3} \times 864 = \mathbf{1.86}$ m/day (Since 1 cm/sec = 864 m/day)

$$v = \frac{q}{A} = \frac{430}{600 \times 50} = 1.435 \times 10^{-2} \text{ cm/sec}$$

$$v = ki = 2.15 \times 10^{-3} \times \frac{40}{6} = 1.435 \times 10^{-2} \text{ cm/sec}$$

ii)



At A–A

$\sigma = 2(20) + 3(18) = 94$ kN/m^2

$u = 5(9.81) = 49.05$ kN/m^2

$\sigma' = (\sigma - u) = 94 - 49.05 = 44.95$ kN/m^2

At B–B

$\sigma = 3(18) = 54$ kN/m^2

$u = 3(9.81) = 29.43$ kN/m^2

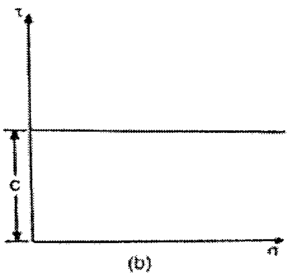
$\sigma' = \sigma - u = 54 - 29.43 = 24.57$ kN/m^2

At C–C

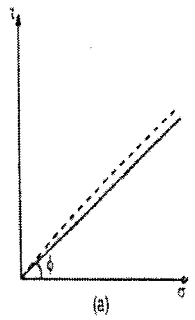
$\sigma = 0$ $u = 0$ $\sigma' = 0$

</td><td>5+5</td><td>23</td></tr>
<tr><td>7</td><td></td><td>5+5</td><td>23</td></tr>
</table>

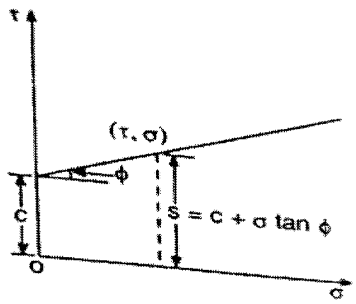
S.No	Compaction	Consolidation
1	Compaction is the compression of soil by the expulsion of air from the voids of the soil.	Consolidation is the compression of soil by the expulsion of water from voids of the soil.
2	It is a quick process.	It is a slow process.
3	Short term loading is required	Long term loading is required.
4	Loading is applied in a dynamic way.	Loading is static and constant.
5	Any type of soil either it is cohesion or Cohesionless can be compacted.	Consolidation applies to cohesive soils only especially for low permeable clay.
6	Degree of saturation of soil to be compacted should be less than 100%.	Degree of saturation of soil to be consolidated should be 100%.



Cohesive soil



Cohesionless soil

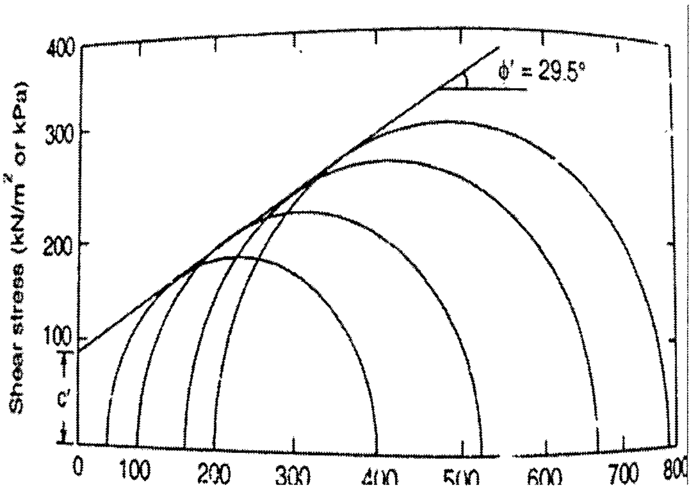


Both cohesive and cohesionless soil

$$\tau = c + \sigma \tan \phi$$

Q No	Solution	Scheme of Marking	Max. Time required for each Question
8	(see below)	5+5	22

σ_3	σ_3'	σ_d	σ_1'
50	45	350	395
100	90	440	530
150	138	530	668
200	182	610	792



C′=8kPa and ϕ′=29.5^0

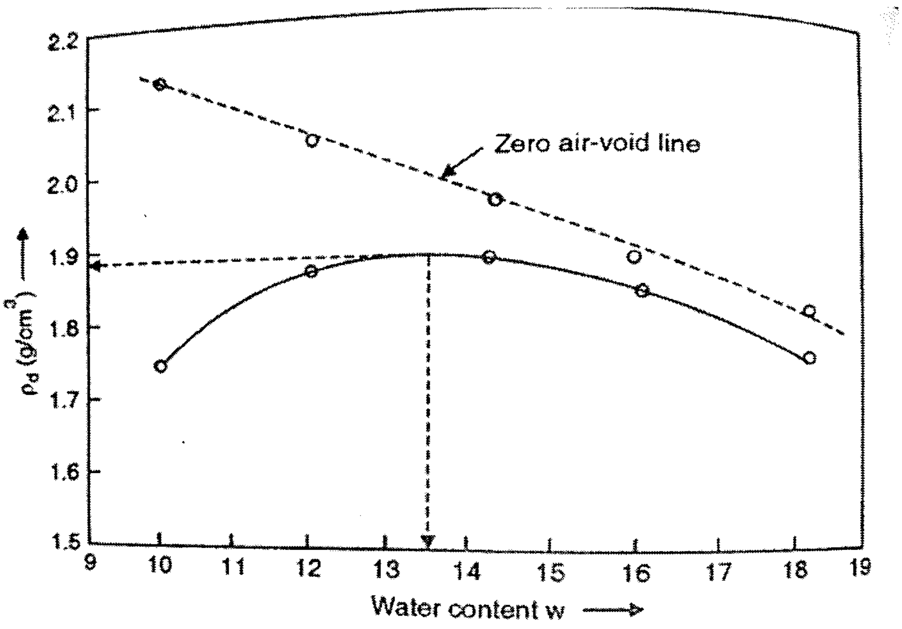
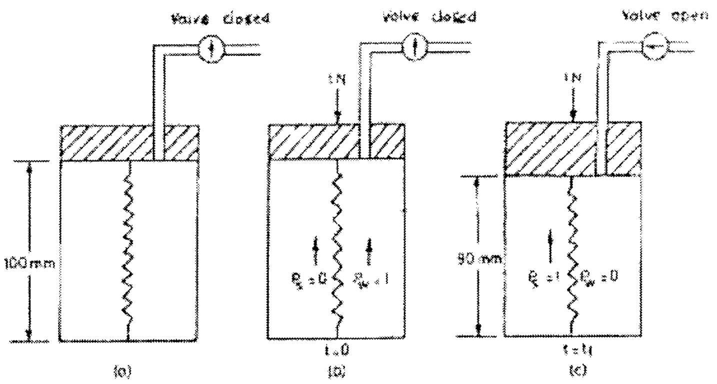
Q No	Solution	Scheme of Marking	Max. Time required for each Question
8	(see below)	5+5	23

S.No.	Water content w	Mass of soil (M) g	$\rho_d = \frac{M}{1000\,(1+w)}\ g/cm^3$	$(\rho_d)_{w} = \frac{2.7}{1+2.7w}\ g/cm^3$
1.	0.10	1925	1.75	2.13
2.	0.12	2095	1.87	2.04
3.	0.143	2150	1.88	1.95
4.	0.161	2125	1.83	1.88
5.	0.182	2070	1.75	1.81

Fig. 17.14 shows the compaction curve along with the zero-air voids line. From the curve $\rho_{d,max} = 1.89\ g/cm^3$ and $w = 0.135$. The degree of saturation is given by

$$\rho_d = 1.89 = \frac{G\rho_w}{1+\frac{wG}{S}} = \frac{2.7\times 1}{1+\frac{0.135\times 2.7}{S}} \quad \text{or} \quad \frac{0.135\times 2.7}{S} = \frac{2.7}{1.89} - 1 = 0.428$$

From which $S = \frac{0.135\times 2.7}{0.428} = 0.852 = 85.2\%$

<table>
<tr><td></td><td>
</td><td></td><td></td></tr>
<tr><td>10</td><td>Normally Consolidated Soil: A soil that has never experienced a vertical effective stress that was greater than its present vertical effective stress is called a normally consolidated (NC) soil.
Overconsolidated Soil: A soil that has experienced a vertical effective stress that was greater than its present vertical effective stress is called an overconsolidated (OC) soil.
Underconsolidated soil: A deposit that is not fully consolidated under the existing overburden pressure.
<u>Spring Analogy</u>
The consolidation process is often explained with an idealized system composed of a spring, a container with a hole in its cover, and water. In this system, the spring represents the compressibility or the structure itself of the soil, and the water which fills the container represents the pore water in the soil.


Spring Analogy.

Given by Terzaghi
The process of consolidation is explained with the help of spring analogy
The system consists of a cylinder fitted with a piston having a valve. The cylinder is filled with water and contains a spring.
Consider initially the length of spring is 100 mm
</td><td>5+5</td><td>23</td></tr>
</table>

- When a load P (say 1N) is applied to the piston, with valve closed, the entire load is taken by water. No load is taken by Spring
  - Load taken by water = 1N
  - Load taken by spring = 0

•If the valve is gradually opened, water starts escaping from the cylinder. The spring starts sharing the load and a decrease in its length occurs
•As more and more water escapes from cylinder, the load carried by the spring increases
•Finally steady conditions are established and the total load is taken by the spring. The load causes a decrease in its length to 90 mm
•Now if the load P is increased to 2N, the process of transfer of load repeats and finally the spring takes the complete load and its length become 80 mm. Likewise the process is repeated.