

- (b) A cohesive soil yields a maximum dry density of 18 kN/m^3 at an OMC of 16% during a standard proctor test. If the value of G_s is 2.65, what is the degree of saturation?

(7M) CO3

UNIT – IV

8. (a) The time required to reach 60% consolidation is 32.50 seconds for a sample 1.0 cm thick tested in the laboratory under the conditions of double drainage. How long will the corresponding layer in nature require to reach the same degree of consolidation if it is 10 m thick and drained only on one side?
- (b) A soil specimen having $c = 86 \text{ kN/m}^2$ and $\phi = 300$ is tested in a triaxial test apparatus. Estimate:
- (i) The deviator stress at which the sample will fail when the cell pressure is 60 kN/m^2 .
- (ii) The cell pressure if the soil sample fails at a major principal stress of 900 kN/m^2 .

(7M) CO4

(7M) CO4

(OR)

9. (a) Derive the governing differential equation for Terzaghi's theory of one dimensional consolidation duly stating the assumptions made their in.
- (b) A saturated specimen of cohesion less sand was tested in triaxial compression and the sample failed at a deviator stress of 400 kN/m^2 , when the cell pressure was 100 kN/m^2 under drained conditions. Find the effective shear strength parameters of sand.

(7M) CO4

(7M) CO4

CE311 (R20)

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CE311 (R20)

B.TECH. DEGREE EXAMINATION, NOVEMBER-2024

Semester V [Third Year] (Regular & Supplementary)

SOIL MECHANICS

Time: Three hours

Maximum Marks: 70

Answer Question No.1 compulsorily. (14 x 1 = 14)

Answer One Question from each unit. (4 x 14 = 56)

1. Answer the following:

- (a) A soil has 80% degree of saturation. What could be its air content? CO1
- (b) Which parameters can be used to estimate the angle of internal friction of a sandy soil? CO1
- (c) If the porosity of soil sample is 20%, the void ratio is _____ CO1
- (d) List out the methods can be used for determining permeability of soils. CO2
- (e) Infer 'Effective stress is just a mathematical term and is not a physical phenomenon'. CO2
- (f) Write down the expression of A-line used in Casagrande plasticity chart. CO2
- (g) Define zero air-void line. CO3
- (h) What is the critical hydraulic gradient of a sand deposit of specific gravity 2.65 and a void ratio of 0.5? CO3
- (i) What is an isobar diagram? CO3
- (j) A dry sand sample was tested in a triaxial machine with the cell pressure of 200 kPa. If the deviator stress at failure is 400 kPa, then what will be the σ_1' and σ_3' value? CO4
- (k) What is coefficient of consolidation? CO4
- (l) Out of UU and CD test which of the test provides effective shear parameters? CO4
- (m) In an un-drained test on saturated clays, both σ_1' and σ_3' is independent of _____. CO4
- (n) What are the different methods followed to determine time factor (Tv)? CO4

UNIT – I

2. (a) Draw typical particle size distribution curves for:
(i) A well-graded soil
(ii) A poorly-graded soil and
(iii) A gap-graded soil.
Which of the above three types would you consider as the best foundation material and why? (7M) CO1
- (b) A borrow area soil has a natural water content of 10% and a bulk density of 1.80 kg/m^3 . The soil is used for an embankment to be compacted at 18% moisture content to a dry density of 1.85 kg/m^3 . Determine the amount of water to be added to 1.0 m^3 of borrow soil. How many cubic meters excavation is required for 1 m^3 of compacted embankment? (7M) CO1

(OR)

3. (a) Explain about Atterberg's limits using appropriate plot and discuss in detail about determination of one of the limits in laboratory along with appropriate plots if necessary. (7M) CO1
- (b) The in-situ percentage voids of a soil deposit is 34%. For determining the density index, dried sand from the stratum was first filled loosely in a 1000 cc mould and was then vibrated to give a maximum density. The loose mass in the mould was 1610 gms and the dense dry mass at the maximum compaction was found to be 1980 gms. Determine the density index. (Take $G_s = 2.67$). (7M) CO1

UNIT – II

4. (a) Define permeability and explain factors affecting permeability. (7M) CO2

- (b) Data from a sieve analysis conducted on a given sample of soil showed that 67% of the particles passed through 75 micron IS sieve. The liquid limit and plastic limit of the finer fraction was found to be 45 and 33 percents respectively. Find the group symbol of the given soil as per IS: 1498-1970. (7M) CO2

(OR)

5. (a) Write a detailed notes on Indian soil classification of soils for coarse grained and fine grained as per IS:1498-1970. (7M) CO2
- (b) In a falling head permeability test, the initial head ($t = 0$) is 40 cm, the head drops by 5 cm in 10 minutes. Calculate the time required to run the test for final head to be 20 cm; if the sample is 6 cm in height and 50 cm^2 in cross sectional area, calculate the coefficient of permeability, taking area of standpipe as 0.50 cm^2 . (7M) CO2

UNIT – III

6. (a) A masonry dam is found on pervious sand having porosity equal to 45% and specific gravity of sand particles is 2.65. Determine the value of maximum permissible upward gradient for a desired factor of safety of 3 against sand boiling. (7M) CO3
- (b) Enumerate the factors affecting compaction of a soil. Briefly discuss the effect of each of them. (7M) CO3

(OR)

7. (a) The load from a continuous footing of width 2 m, which may be considered to be strip load of considerable length, is 200 kN/m^2 . Determine the maximum principal stress at 1.5 m depth below the footing, if the point lies (i) directly below the centre of the footing (ii) directly below the edge of the footing and (iii) 0.8 m away from the edge of the footing. (7M) CO3

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- (b) Determine (i) Maximum dry density and optimum moisture content (ii) Draw zero air voids curve (iii) the percentage of air voids at MDD from the results of IS light compaction test given below: (7M) CO3

Volume of the mould = 1000 cm ³					
Mass of soil (g)	2022	2066	2118	2093	2063
Water content (%)	8.5	10.2	12.5	14.3	15.6

UNIT – IV

8. (a) Define the terms a_v , m_v , C_v and C_c . (7M) CO4
 (b) Determine the change in thickness of the clay layer if a 4 m thick layer of NCC has an average void ratio of 1.3. Its compression index is 0.6. If the increase in vertical pressure due to the foundation load on the clay layer is equal to the existing effective overburden pressure. (7M) CO4

(OR)

9. (a) Explain in detail the procedure to find the shear strength of soil specimen using the direct shear test. (7M) CO4
 (b) Determine the effective stress strength parameters, C^1 and ϕ^1 by the Mohr's circle method from the results obtained from CU triaxial stress conducted on specimens of a saturated clay soil given below. (7M) CO4

Cell Pressure σ_3 (kN/m ²)	Additional axial stress $(\sigma_1 - \sigma_3)$ or deviator stress at failure	Pore water pressure (u) at failure (kN/m ²)
150	102	80
300	200	164
450	304	264
600	405	325

CE311 (R20)

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CE311 (R20)

B.TECH. DEGREE EXAMINATION, APRIL-2024

Semester V [Third Year] (Supplementary)

SOIL MECHANICS

Time: Three hours

Maximum Marks: 70

Answer Question No.1 compulsorily. (14 x 1 = 14)

Answer One Question from each unit. (4 x 14 = 56)

1. Answer the following:
- Define degree of saturation and percentage air voids. CO1
 - What do we call the soils that are transported by air? CO1
 - List the corrections to be applied to the hydrometer reading. CO1
 - Define coefficient of curvature and its range for well-graded sand. CO2
 - What is the best-suited method to determine stresses due to applied loads for stratified deposits? CO2
 - What are the conditions necessary for Darcy's law to be applicable for flow of water through soil? CO2
 - Distinguish between discharge velocity and seepage velocity. CO3
 - A 1000 kN load is uniformly distributed on surface area of 3 m x 2.5 m. Calculate the approximate value of vertical stress at a depth of 2 m using 2:1 dispersion. CO3
 - The OMC & MDD are 15% and 18 kN/m³ respectively. Assume $G = 2.7$, What will be the percentage air voids at OMC. CO3
 - Define quick sand condition. CO3
 - Distinguish between NCC and OCC. CO4
 - What is secondary consolidation? CO4
 - Write the equation for Coulomb's shear strength. CO4

- (n) What is the test used to determine the shear strength of soil in the field? CO4

UNIT – I

2. (a) Explain in detail the major soil deposits of India. (7M) CO1
 (b) Derive the equation: $r_d = \frac{(1-n_a)G\gamma_w}{(1+wG)}$ (7M) CO1

(OR)

3. (a) Define shrinkage limit. Explain the experimental procedure for the determination of the shrinkage limit. Also derive the formula for shrinkage limit. (7M) CO1
 (b) A soil sample has a liquid limit of 25% and a flow index of 12.5%. Determine the plasticity index and toughness index. If the water content of the soil in its natural condition in the field is 20%, determine the liquidity index and relative consistency. (7M) CO1

UNIT – II

4. (a) Explain in detail the Indian soil classification system of coarse-grained soils. (7M) CO2
 (b) The result of the lab test conducted on a given soil is as follows. Classify the soil based on the below result. (7M) CO2
 % Weight of soil passing through 75 μ m sieve = 75
 % Weight of soil passing through 4.75 mm sieve = 100
 Liquid limit = 58% & Plastic limit = 14%

IS Sieve size (mm)	4.75	2.00	1.0	0.425	0.212	0.150	0.075
Mass of soil retained in (gms)	12.0	48.4	92.5	156.5	201.2	106.2	63.2

(OR)

5. (a) Define the term “effective stress” and explain its importance. (7M) CO2
 (b) Sandy soil 5 m deep is followed by clay of depth 3 m. The properties of sandy soil are “ $e = 0.6$ $S_r = 40\%$ and $G = 2.65$ ”. The properties of clayey soil are “ $G = 2.70$ and $w = 45\%$ ”. Water-table is at a depth of 3m from the ground surface. Assume unit weight of water: 10 kN/m³. Determine the total, neutral and effective stress at a depth of 3 m, 5 m and 8 m from the ground surface. Draw the total stress, neutral stress and effective stress diagrams at a depth of 8 m. Neglect capillary flow. If the water table rises to the ground surface, determine the effective stress and change in effective stress at a depth of 8 m from the ground surface. (7M) CO2

UNIT – III

6. (a) Explain in detail the various properties of flow net. (7M) CO3
 (b) A large excavation was made in a stratum of stiff clay with a saturated unit weight of 18.64 kN/m³. When the depth of excavation reached 8 m, the excavation failed as a mixture of sand and water rushed in. Subsequent borings indicated that clay was underlain by a bed of sand with its top surface at a depth of 12.5 m. Determine the height to which water has risen above the stratum of sand into the drill hole before the excavation started. (7M) CO3

(OR)

7. (a) What is compaction? Explain in detail the factors affecting compaction. (7M) CO3

UNIT – IV

8. (a) Explain Terzaghi's theory of consolidation in brief. (7M) CO4
 (b) The result of a series of CU test on undistributed samples of over consolidated clay were as follows: (7M) CO4

Cell Pressure (kN/m ²)	100	200	400	600
Deviator stress at failure (kN/m ²)	300	410	610	850
Pore water pressure at failure (kN/m ²)	-45	-15	50	110

Determine the shear strength parameters in terms of effective stresses.

(OR)

9. (a) Explain briefly Direct Shear Test with advantages and disadvantages. (7M) CO4
 (b) A clay layer, whose total settlement under a given loading is expected to be 12 cm settles 3 cm at the end of 1 month after the application of load increment. How many months will be required to reach a settlement of 6 cm? How much settlement will occur in 10 months? (7M) CO4

CE311 (R20)

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CE311 (R20)

B.TECH. DEGREE EXAMINATION, DECEMBER-2023

Semester V [Third Year] (Regular & Supplementary)

SOIL MECHANICS

Time: Three hours

Maximum Marks: 70

Answer Question No.1 compulsorily. (14 x 1 = 14)

Answer One Question from each unit. (4 x 14 = 56)

1. Answer the following:
- (a) Define degree of saturation and dry unit weight of soil. CO1
 - (b) What is the meaning of Alluvial soil deposit and Marine deposit? CO1
 - (c) Define the term relative density. CO1
 - (d) What is quick sand condition of soil? CO2
 - (e) Soil classification symbol SP stands for _____. CO2
 - (f) Explain the Geostatic stress. CO2
 - (g) Write Westerguard's equation for calculating vertical stress below point load. CO3
 - (h) State the applications of Flow Net. CO3
 - (i) The OMC & MDD are 15% and 18 kN/m³ respectively. Assume G = 2.7, the percentage of air voids at OMC is _____. CO3
 - (j) Explain Zero Voids or saturation curve for compacted soil. CO4
 - (k) State the factors affecting consolidation. CO4
 - (l) What is secondary consolidation? CO4
 - (m) Define ultimate strength and residual strength of soil. CO4
 - (n) Explain the use of Vane shear test and its equation. CO4

UNIT – I

2. (a) Explain regional soil deposits of India with geotechnical properties.

(7M) CO1

- (b) Following are the details of laboratory test on a sample of soil.

Bulk density by Core Cutter = 2000 kg/m^3

$G = 2.7$ and water content = 25%

Determine dry density, porosity and degree of saturation.

(7M) CO1

(OR)

3. (a) Determine flow index, liquidity index and consistency index when $W_l = 65\%$, $W_p = 38\%$, $W_n = 45\%$ and the number of jerks is 32 at $w = 38\%$.

(7M) CO1

- (b) Explain in detail the following:

(7M) CO1

- (i) Consistency Index
(ii) Flow Index
(iii) Toughness Index

UNIT – II

4. (a) Explain in brief Indian Soil Classification System and use of soil classification system.

(7M) CO2

- (b) A permeameter of 80 mm diameter with a sample length of 300 mm has been used for constant head tests. While conducting a constant head test the loss of head was 1150 mm for a length of 250 mm and the rate of flow was $2700 \text{ mm}^3/\text{sec}$. Find the coefficient of permeability in mm/sec. If a falling head test was carried out on the same sample at the same void ratio, find the time taken for head to fall from 900 mm to 450 mm. The diameter of pipe is 25 mm in the falling head test.

(7M) CO2

(OR)

5. (a) The following data on consistency limits are available for two soils A and B. Find which soil is more plastic, better foundation material on remoulding.

(7M) CO2

	Soil A	Soil B
Plastic limit	21%	19%
Liquid limit	38%	47%
Flow index	13	8
Natural water content	32%	40%

- (b) What will be the ratio of average permeability in horizontal direction to that in the vertical direction for a soil deposit consisting of three horizontal layers, if the thickness and permeability of the second layer are twice of those of the first and those of the third layer twice those of second?

(7M) CO2

UNIT – III

6. (a) Derive the Laplace equation for two dimensional flow.

(7M) CO3

- (b) A water tank is supported by a ring foundation having outer diameter of 10 m and inner diameter of 7.5 m. The ring foundation transmits uniform load intensity of 160 kN/m^2 . Compute the vertical stress induced at a depth of 4 m, below the centre of ring foundation, using (i) Boussinesq analysis and (ii) Westergaard's analysis, taking $\mu = 0$.

(7M) CO3

(OR)

7. (a) The following observations were recorded in a Standard Proctor Test. Find MDD and OMC. Also draw zero air void line.

(7M) CO3

Water Content (%)	10	12	14.3	16.1	18.2
Mass of solid and wet soil (g)	2925	3095	3150	3125	3070

- (b) Explain Boussinesq's method of calculating stress briefly with assumption.

(7M) CO3

- (b) Two identical soil specimens were tested in a triaxial apparatus. First specimen failed at a deviator stress of 770 kN/m^2 when the cell pressure was 200 kN/m^2 . Second specimen failed at a deviator stress of 1370 kN/m^2 under a cell pressure of 400 kN/m^2 . Determine the value of 'c' and 'ø' analytically. If the same soil is tested in a direct shear apparatus with a normal stress of 600 kN/m^2 , estimate the shear stress at failure. (7M) CO4

(OR)

9. (a) State Mohr-Coulomb's equation for shear strength of soil. Discuss the factors which affect the shear strength parameters of soil. (7M) CO4
- (b) Two clay specimens A and B, of thickness 2 cm and 3 cm, has equilibrium voids ratio 0.65 and 0.70 respectively under a pressure of 200 kN/m^2 . If the equilibrium voids ratio of the two soils reduced to 0.48 to 0.60 respectively when the pressure was increased to 400 kN/m^2 , find the ration of coefficients of permeability of the two specimens. Time required by the specimen A to reach 40 degree of consolidation is one fourth of that required by specimen B for 40% degree of consolidation. (7M) CO4

CE311 (R20)

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CE311 (R20)

B.TECH. DEGREE EXAMINATION, JUNE-2023

Semester V [Third Year] (Supplementary)

SOIL MECHANICS

Time: Three hours

Maximum Marks: 70

Answer Question No.1 compulsorily. (14 x 1 = 14)

Answer One Question from each unit. (4 x 14 = 56)

1. Answer the following:

- (a) State the difference between Voids ratio and Porosity. CO1
- (b) List out four regional deposits of soil in India. CO1
- (c) Define Liquidity Index and Plasticity Index. CO1
- (d) State the Darcy's law. CO2
- (e) Soil classification symbol GW stand for _____. CO2
- (f) Explain the Effective Stress formula. CO2
- (g) State the Boussinesq's equation for calculating vertical stress below point load. CO3
- (h) State the properties of Flow Net. CO3
- (i) A constant head permeability test was carried out on a cylindrical sample of soil 10 cm diameter and 15 cm height. 160 cm^3 of water collected in 2 min under a head to 30 cm. Compute the coefficient of permeability in m/sec. CO3
- (j) List factors affecting compaction. CO4
- (k) State the difference between compression and consolidation. CO4
- (l) In Vane Shear test on clay, the following observations are made:
 Applied Torque = 183 kg cm
 Height of Vane = 10 cm
 Diameter of Vane = 5 cm
 Calculate the strength of Clay. CO4
- (m) What is liquifaction of soil? CO4
- (n) State three advantages of direct shear test. CO4

UNIT – I

2. (a) List regional soil deposits of India and explain any two. (7M) CO1
 (b) The void ratio and specific gravity of a sample of clay are 0.73 and 2.7 respectively. If the voids are 92% saturated, find the bulk density, dry density and water content. What would be the water content for complete saturation, the void ratio remaining the same? (7M) CO1

(OR)

3. (a) Explain Atterberg's limits in graphical presentation. Also explain Toughness index, Liquidity index and consistency index. (7M) CO1
 (b) Starting from first principles derive the following equation with usual nomenclature (7M) CO1

$$\gamma = \frac{(G + eS_r)\gamma_w}{(1 + e)}$$

UNIT – II

4. (a) Explain in brief Unified Soil Classification System. (7M) CO2
 (b) While determining the permeability of a soil sample using variable head permeameter, the water head is dropped from 100 cm to 60 cm in 10 minutes: (7M) CO2
 (i) How much will it further drop in the next 10 minutes
 (ii) How much time will be required to drop the head from 60 cm to 20 cm.

(OR)

5. (a) The following data on consistency limits are available for two soils A and B. Find which soil is more plastic, better foundation material on remoulding. (7M) CO2

	Soil A	Soil B
Plastic limit	16%	19%
Liquid limit	30%	52%
Flow index	11	6
Natural water content	32%	40%

- (b) Explain the permeability of stratified soil deposits for parallel to the bedding planes and perpendicular to the bedding planes. (7M) CO2

UNIT – III

6. (a) Derive the Laplace equation for two dimensional flow. (7M) CO3
 (b) Find out the vertical pressure at depths 3 m and 4 m directly below a load of 500 kN when: (7M) CO3
 (i) The load acts as point load.
 (ii) The load is spread over circular area of radius 2 m on the surface.
 Use Boussinesq's equation.

(OR)

7. (a) The following observations were recorded in a Standard Proctor Test. Find MDD and OMC (7M) CO3
- | | | | | | |
|-----------------------------------|-------|-------|-------|-------|-------|
| Water Content (%) | 16.10 | 19.50 | 27.55 | 33.69 | 34.77 |
| Bulk Density (Kg/m ³) | 1310 | 1515 | 1875 | 1860 | 1775 |
- (b) Explain approximate methods for calculating vertical stress on soil. (7M) CO3

UNIT – IV

8. (a) Explain Spring Analogy method of consolidation in brief. (7M) CO4

- (b) The friction angle ' ϕ ' of a normally consolidated clay specimen, determined from a drained triaxial shear test is 25° . The unconfined compressive strength of a similar specimen was found to be 100 kPa. Determine the pore water pressure at failure for the unconfined compression test. (7M) CO4

(OR)

9. (a) What are different shear tests of soil? Explain any one of the shear tests with a neat sketch. (7M) CO4
- (b) A saturated clay layer is 10 m thick underlain by an impervious stratum. The natural water content of clay is 40% and its liquid limit is 48%. What will be the consolidation settlement of clay if the foundation load increases the vertical pressure by 50% of its initial overburden pressure? The clay is normally consolidated and the specific gravity of clay is 2.70. (7M) CO4

CE311 (R20)

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CE311 (R20)

B.TECH. DEGREE EXAMINATION, MARCH-2023

Semester V [Third Year] (Regular)

SOIL MECHANICS

Time: Three hours

Maximum Marks: 70

Answer Question No.1 compulsorily. (14 x 1 = 14)

Answer One Question from each unit. (4 x 14 = 56)

1. Answer the following:

- (a) Distinguish between void ratio and porosity of soils. CO1
- (b) What are Atterberg limits? CO1
- (c) Draw phase diagram for dry soil. CO1
- (d) Determine plasticity index if the range of water content at which soil remains in plastic state is 30 % to 50 %? CO1
- (e) Give the names of group symbols for GW and CH. CO2
- (f) List the factors influence the permeability. CO2
- (g) What is capillarity? CO2
- (h) Write the importance of effective stress. CO2
- (i) Mention the most suitable rollers to compact the cohesive soils. CO3
- (j) Draw flow net for $N_f = 3$ and $N_d = 4$. CO3
- (k) A concentrated load of 1000 kN acts vertically at a point on the soil surface. According to Boussinesq's equation, calculate the vertical stress at depths of 3 m. CO3
- (l) Derive the relationship between coefficient of compressibility and coefficient of volume change. CO4
- (m) Determine the compression index of an undisturbed soil sample having liquid limit 40%. CO4
- (n) What is quick triaxial compression test? CO4

UNIT – I

2. (a) Define the terms water content, void ratio, specific gravity of solids and degree of saturation and also derive the relation between them. (7M) CO1

- (b) The liquid limit, plastic limit and natural moisture content of soil are given as 50%, 35% and 25%. What will be the values of plasticity index, liquidity index and consistency index? (7M) CO1

(OR)

3. (a) List and explain about the various indices used for classification of soil. (7M) CO1
- (b) A partially saturated sample from a borrow pit has a natural moisture content of 15% and bulk unit weight of 1.9 g/cc. The specific gravity of solids is 2.70. Determine the degree of saturation and void ratio. What will be the unit weight of the soil if it gets fully saturated? (7M) CO1

UNIT – II

4. (a) Explain with the help of particle size distribution curves for the following types of soils: (7M) CO2
- Well graded
 - Uniformly graded
 - Gap graded
- (b) What will be the IS Classification for the soil given below: (7M) CO2
- Passing 4.75 mm sieve = 70 %
 Passing 75 μ sieve = 8 %
 Plasticity index = 3 %
 Coefficient of uniformity = 7
 Coefficient of curvature = 3

(OR)

5. (a) Illustrate the method of determination of coefficient of permeability for cohesive soils. (7M) CO2

- (b) A stratified soil deposit consists of two layers. The top layer is 2.5 m thick having a bulk density of 17 kN/m³ and the bottom layer is 3.5 m thick having a saturated density of 21 kN/m³. The water table is at a depth of 3.5 m from the surface and the zone of capillary saturation is 1 m above the water table. Draw the diagrams showing the variation of total, neutral and effective stresses. (7M) CO2

UNIT – III

6. (a) What is flow net? Explain the properties and uses of flow net. (7M) CO3
- (b) A concentrated load of 50 kN acts on the surface of a homogeneous soil mass of large extent. Determine the stress intensity at a depth of 5 m, directly under the load, and at a horizontal distance of 2.5 m. (7M) CO3

(OR)

7. (a) Explain the factors affecting the compaction of soil and relative compaction. (7M) CO3
- (b) The following results were obtained from a IS light weight compaction test on sample of soil.

Water content (%)	0.12	0.14	0.18	0.21	0.24
Mass of wet soil (kg)	1.65	1.95	1.93	1.90	1.86

Plot compaction curve. Hence obtain the values of OMC and MDD. (7M) CO3

UNIT – IV

8. (a) What is meant by pre-consolidation pressure? Explain with the help of a neat sketch, the Casagrande's procedure to determine pre-consolidation pressure. (7M) CO4