INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING

Assignment Questions

Course name	**GEOTECHNICAL ENGINEERING**
Course code	**A50120**
Class	III – B. Tech I- Semester
Branch	Civil Engineering
Academic year	2017 – 2018
Course coordinator	Ms.J.Hymavathi, Ms. B. Navya, Assistant Professor, Civil Engineering Dept.
Course faculty	Ms.J.Hymavathi, Ms. B. Navya, Assistant Professor, Civil Engineering Dept.

OBJECTIVES

The objective of the teacher is to impart knowledge and abilities to the students to:

I. Introduce the students to the basic concept of soils
II. Learn the formation and structure of soil
III. Understand the index and engineering properties and standard classifications of soils
IV. Know the permeability of soil and laboratory determination of coefficient of permeability
V. Understand seepage through soils

S. No	Question	Blooms Taxonomy Level	Program Outcome
	UNIT – I Introduction & Index Properties of Soil		
1	Explain the process of formation of soil	Understand	1
2	With the help of three phase diagram, define the following: (i) Voids ratio (ii) Porosity (iii) Degree of saturation (iv) Water content (v) Absolute/true specific gravity (vi) Apparent specific gravity (vii) Air content (viii) Percentage of air voids and (ix) Relative density.	Remember	2
3	A sample weighing 20kn/m^3 and has water content of 20%. The specific gravity of soil particles is 2.68. Determine void ratio and porosity and differentiate between the two methods of sieve analysis.	Understand	2
4	Discuss the importance of Atterberg's limits of soil. What are the main index properties of fine grained soils? How are these determined in laboratory?	Remember	2
5	What are the uses of consistency limits? What are their limitations?	Remember	2
6	What is the use of classification of soils? Discuss the Indian standard classification system?	Understand	2
7	An undisturbed sample of soil has a volume 100cm3 and mass	Understand	2

<table>
<tr><td></td><td>200g. on oven drying for 24 hours, the mass is reduced to 170g. If G= 2.68. Determine the (i) void ratio (ii) water content and (iii) degree of saturation of soil.</td><td></td><td></td></tr>
<tr><td>8</td><td>A cylindrical specimen of cohesive soil 10cm dia and 20cm length is prepared in a mould. If the wet weight is 2.25 kg and water content is 15%. Determine the dry unit weight and the void ratio. If G=2.7 determine the degree of saturation of the sample.</td><td>Understand</td><td>2</td></tr>
<tr><td>9</td><td>The moisture content of an undisturbed sample of clay belonging to a volcanic region is 265% under 100% saturation. The specific gravity of the solids is 2.5. The dry unit weight is 21 kN/m^3. Determine (i) the saturated unit weight, (ii) the submerged unit weight, and (iii) void ratio.</td><td>Understand</td><td>2</td></tr>
<tr><td>10</td><td>500g of dry soil was used for sieve analysis. The masses of soil retained on each sieve is given below:
<table>
<tr><td>IS sieve</td><td>Mass in g</td><td>IS sieve</td><td>Mass in g</td></tr>
<tr><td>2.0mm</td><td>10</td><td>250 µ</td><td>145</td></tr>
<tr><td>1.4mm</td><td>18</td><td>125 µ</td><td>56</td></tr>
<tr><td>1.0mm</td><td>60</td><td>75µ</td><td>45</td></tr>
<tr><td>500µ</td><td>135</td><td></td><td></td></tr>
</table>
Plot a grain distribution curve and compute the following the % of gravel, coarse sand, medium sand, fine and silt as per IS:1498-1959. Find the uniformity coefficient, and coefficient of curvature.</td><td>Understand</td><td>3</td></tr>
<tr><td colspan="4">UNIT 2
Permeability & Effective stress & seepage through soils</td></tr>
<tr><td>1</td><td>Explain the factors affecting the permeability of soil.</td><td>Understand</td><td>3</td></tr>
<tr><td>2</td><td>Discuss the properties and applications of flow nets and explain quick sand phenomenon.</td><td>Understand</td><td>5</td></tr>
<tr><td>3</td><td>Describe pumping-out method for the determination of the coefficient of permeability in the field?</td><td>Understand</td><td>3</td></tr>
<tr><td>4</td><td>What is seepage velocity, coefficient of percolation and quick sand.</td><td>Understand</td><td>4</td></tr>
<tr><td>5</td><td>What is a flow net? Describe its properties and applications. Describe different methods used to construct the flow net.</td><td>Remember</td><td>5</td></tr>
<tr><td>6</td><td>Define the total stress, neutral stress and effective stress. What is the importance of the effective stress?</td><td>Remember</td><td>6</td></tr>
<tr><td>7</td><td>In a falling head permeameter, the sample used is 20 cm long having a cross-sectional area of 24 cm^2. Calculate the time required for a drop of head from 25 to 12 cm if the cross sectional area of the stand pipe is 2 cm^2. The sample of soil is made of three layers. The thickness of the first layer from the top is 8 cm and has a value of $k_1 = 2 \times 10^{-4}$ cm/sec, the second layer of thickness 8 cm has $k_2 = 5 \times 10^{-4}$ cm/sec and the bottom layer of thickness 4 cm has & $k_3 = 7 \times 10^{-4}$ cm/sec. Assume that the flow is taking place perpendicular to the layers</td><td>Understand</td><td>4</td></tr>
<tr><td>8</td><td>The following details refer to a test to determine the permeability of the soil: Thickness of specimen =25 mm; diameter of specimen= 75 mm; diameter of standing pipe=10</td><td>Understand</td><td>3</td></tr>
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<tr><td></td><td>mm; initial head at start=1000 mm; water level after 3hrs 20 minutes= 800 mm. Determine the permeability of the soil. If voids ratio of the sample is 0.75, what is the permeability of the same soil at a voids ratio of 0.9?</td><td></td><td></td></tr>
<tr><td>9</td><td>If a falling head permeameter test the initial head is 40 cm. The head drops by 5cm in 10 minutes. Calculate the time required to run the test for the final head to be 20cm. If the sample is 6 cm in height and 50 cm^2 in cross sectional area, calculate the coefficient of permeability taking area of stand pipe = 0.5 cm^2.</td><td>Understand</td><td>3</td></tr>
<tr><td>10</td><td>Compute the critical hydraulic gradients for the following materials: a) coarse gravel, k=10cm/s, G=2.67, e=0.65 b) Sandy silt, k=10^{-6}cm/s, G=2.67, e=0.80</td><td>Understand</td><td>3</td></tr>
<tr><td colspan="4">UNIT 3
Stress Distribution in Soils & Compaction</td></tr>
<tr><td>1</td><td>Derive as per Boussinesq’s theory, expression for vertical stress at any point in a soil mass due to strip load.</td><td>Remember</td><td>6</td></tr>
<tr><td>2</td><td>Explain the Newmark’s Influence charts and their uses.</td><td>Understand</td><td>7</td></tr>
<tr><td>3</td><td>Describe standard proctor test and the modified proctor test.</td><td>Understand</td><td>8</td></tr>
<tr><td>4</td><td>What are the different methods of compaction adopted in the field? How would you select the type of roller to be used in the field?</td><td>Understand</td><td>8</td></tr>
<tr><td>5</td><td>What are the methods adopted for measuring the density of the compacted soil? Briefly describe the on which will suit all types of soils.</td><td>Remember</td><td>8</td></tr>
<tr><td>6</td><td>What do you understand by geostatic stresses? How are these determined?</td><td>Understand</td><td>6</td></tr>
<tr><td>7</td><td>Two columns A and B are standing 5m apart. Load transferred through them may be taken as point load. Through column A a load of 400 kN are acting. Calculate the resultant vertical pressure due to these load on a horizontal plane 2m below the ground surface at points vertically below the column A and B.</td><td>Understand</td><td>6</td></tr>
<tr><td>8</td><td>A bed of compressible clay 4 m thick has pervious sand on the top and impervious rock at the bottom. In a consolidation test on an undisturbed sample of clay from this deposit, 90% settlement was reached in 4 hours. The sample was 20 mm thick. Estimate the time in years for the building founded over this deposit to reach 90% of its settlement.</td><td>Understand</td><td>6</td></tr>
<tr><td>9</td><td>Following are the observations of a compaction test
<table><tr><td>Water content (%)</td><td>7.7</td><td>11.5</td><td>14.6</td><td>17.5</td><td>19.25</td><td>2.1</td></tr><tr><td>Weight of wet soil (N)</td><td>16.67</td><td>18.54</td><td>19.92</td><td>19.52</td><td>19.23</td><td>18.83</td></tr></table>If the volume of the compaction mould is 950 cc, assuming G=2.65.
(i) Draw the compaction curve (ii) Report the maximum dry unit weight and optimum moisture content (iii) Draw 100%</td><td>Understand</td><td>6</td></tr>
</table>

	saturation line		
10	There is a line load of 120kN/m acting on the ground surface along y-axis. Determine the vertical stress at a point P which has x and z co-ordinates as 2m and 3.5m respectively.	Understand	7
	UNIT 4 **Consolidation**		
1	Discuss Terzaghi's theory of consolidation, stating the various assumptions and their validity	Remember	9
2	Explain the different e-log p curves for the consolidation.	Remember	9
3	How do you determine the pre-consolidation pressure and its determination in soil engineering practice	Remember	9
4	Write a brief procedure of consolidation test and to determine the coefficient of consolidation by both logarithmic time fitting method and square root of time method.	Understand	9
5	What is over consolidation soil? Explain briefly with an example.	Remember	9
6	Explain the square root of time fitting method of determining the coefficient of consolidation of a clay sample.	Understand	9
7	Define the following terms: (i) Coefficient of compressibility (ii) Coefficient of volume change (iii) Compression index (iv) Expansion index (v) Recompression index	Remember	9
8	Saturated soil of 5 m thick lies above an impervious stratum and below a pervious stratum. It has a compression index of 0.25 with $k = 3.2\times10^{-10}$ m/sec. Its void ratio at a stress of 147 kN/m^2 is 1.9. Compute (i) The change in voids ratio due to increase of stress to 196 kN/m (ii) Coefficient of volume compressibility (iii) Coefficient of consolidation (iv) Time required for 50% consolidation.	Understand	9
9	A layer of submerged soil 8m thick is drained at its upper surface but is underlain by impermeable shale. The sol is subjected to a uniform vertical stress which is produced by the construction of an extensive embankment on the ground surface. If the coefficient of consolidation for the soil is 2×10^{-3} cm^2/sec calculate the times when 50% and 90% respectively of the final settlement will take place. Consider T_{50} =0.197	Understand	9
10	A recently completed fill was 10m thick and its initial average void ratio was 1.0. The fill was loaded on the surface by constructing an embankment covering a large area of the fill. Some months after the embankment was constructed, measurements of the fill indicated an average void ratio of 0.8. Estimate the compaction of the fill.	Understand	9
	UNIT 5 **Shear Strength of Soils**		
1	Explain Mohr-Coulomb theory of shear strength. Sketch typical strength envelope for a soft clay, clean sand and a silty clay	Remember	10
2	What types of field tests are necessary for determining the shear strength parameters of sensitive clays?	Remember	10

<table>
<tr><td>3</td><td>Explain about triaxial compression test</td><td>Understand</td><td>10</td></tr>
<tr><td>4</td><td>Discuss modified failure envelope. What are its advantages and disadvantages over the standard failure envelope?</td><td>Remember</td><td>10</td></tr>
<tr><td>5</td><td>Explain liquefaction of soils.</td><td>Understand</td><td>10</td></tr>
<tr><td>6</td><td>A remoulded specimen of soil prepared by compaction to standard proctor maximum dry unit weight at optimum moisture content is used for consolidated-undrained triaxial test with pore pressure measurements. The test results are given below:
<table>
<tr><td>Test No</td><td>Cell pressure (kN/m^2)</td><td>Deviator stress at failures (kN/m^2)</td><td>Pore pressure (kN/m^2)</td></tr>
<tr><td>1</td><td>40</td><td>300</td><td>05</td></tr>
<tr><td>2</td><td>100</td><td>443</td><td>10</td></tr>
<tr><td>3</td><td>165</td><td>615</td><td>12</td></tr>
</table>
Determine the values of effective shear stress parameters by
(i) Drawing Mohr envelope (ii) Drawing modified envelope</td><td>Understand</td><td>10</td></tr>
<tr><td>7</td><td>A direct shear test was conducted on a soil, whose results are given below:
<table>
<tr><td>Normal stress, kN/m^2</td><td>150</td><td>250</td></tr>
<tr><td>Shear stress at failure kN/m^2</td><td>110</td><td>120</td></tr>
</table>
Plot the graph and determine the shear strength of parameters of the soil. If a triaxial test is conducted on the same soil, what would be the deviator stress at failure when the cell pressure is 150 kN/m^2</td><td>Understand</td><td>10</td></tr>
<tr><td>8</td><td>A direct shear test was performed on a 6cm x 6cm sample of dry sand the normal load was 360N. The failure occurred at a shear load of 180N.Plot the Mohr strength envelope and determine ∞ . Assume c=0 also determine principal stress at failure.</td><td>Understand</td><td>10</td></tr>
<tr><td>9</td><td>A drained triaxial test on sand with σ_3' =150 kN/m^2 gave (σ_1'/σ_3') =3.7. Compute (a) σ_{1f}' (b) $(\sigma_1-\sigma_3)_f$ and ϕ'.</td><td>Understand</td><td>10</td></tr>
<tr><td>10</td><td>At a depth of 6m below the ground surface at a site, a vane shear tests gave a torque value of 6040N-cm. The vane was 10cm high and 7cm across the blades. Estimate the shear strength of the soil.</td><td>Understand</td><td>10</td></tr>
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