

B.E. CIVIL ENGINEERING THIRD YEAR FIRST SEMESTER EXAM 2018
 (1st /2nd Semester/Repeat/Supplementary /Spl. Supplementary /Old/Annual/Bi-Annual)

SUBJECT: SOIL MECHANICS- I

(Name in full)

Time: ~~Two hours/ Three hours/Four hours/Six hours~~

Full Marks ~~30/100~~

(15/50 marks for each part)

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|-----------------|--|------------|
| No. of Question | <ul style="list-style-type: none"> • <i>Maintain neatness.</i> • <i>Answer ALL questions.</i> • <i>Assume reasonable data if it is not supplied.</i> • <i>All drawings-must be drawn by pencil</i> | Marks (40) |
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- | | | |
|--------|---|----|
| (1)(a) | What are meant by Atterberg limits? | 2 |
| (b) | The Atterberg limits of a given soil are, LL= 50%, PL= 40% and SL= 22%. The specific gravity of soil solids is 2.67. The sample of the soil at LL has a volume of 20 cc. What will be the final volume of the soil if the sample is brought to its Shrinkage limit? | 4 |
| (c) | Explain all the corrections required during the hydrometer test. | 4 |
| (d) | Draw Casagrande's Plasticity chart by Pencil and Classify soil A and soil B as given below. Also compare qualitatively the shear strength, compressibility and permeability of the soils with justification. | 10 |
- | | | |
|------------------------------|--------|--------|
| | Soil A | Soil B |
| LL (%) | 60 | 48 |
| PL (%) | 21 | 18 |
| Natural moisture content (%) | 42 | 36 |
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- | | | |
|--------|--|-----|
| (2)(c) | It is required to construct an embankment having a total volume of 64000 m ³ . The required soil is to be collected from borrow pits. It was found that existing soil has a moisture content of 14%, void ratio is 0.63 and specific gravity is 2.68. Laboratory tests indicate that the OMC and γ_{dmax} of the soil is 19.5% and 1.72 gm/cc, respectively. The soil is to be carried from the borrow pit to the construction site by trucks having average net carrying capacity of 5.5 t. Determine the number of trips the trucks have to make for constructing the entire embankment. Also find out the quantity of water to be added to the borrowed soil before compaction. | 5+3 |
| (b) | The water table in a certain deposit of soil is at a depth of 4.6 m below GL. The soil consists of clay down to 5.5 m below GL. This is followed by a deep sand stratum. The soil above the water table is saturated. Given that for clay $w = 36\%$, $G = 2.70$ and for sand $w = 27\%$, $G = 2.67$. Draw the distribution of total, effective stress and pore-water pressure down to 12m below GL. What will be the change in effective stress, if the water table rises by 2.00 m. | 10 |
| (c) | In case of coarse grained soil, which permeability test (Falling head permeability test or Constant head permeability test) is preferable and why? | 2 |
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- | | | |
|--------|--|---|
| (3)(a) | Deduce Laplace equation in respect of seepage through soil. | 8 |
| (b) | In order to determine the field permeability of a free aquifer, pumping out test was performed and following observations were made:
Diameter of well: 20 cm, Discharge of the well= 240m ³ /hour, R.L. of original water surface, before pumping started= 240.5 m, R.L. of water level in well at constant pumping = 235.6 m, R.L. of impervious layer= 210m, R.L. of water in observation well= 239.8m, Radial distance of observation well from tube well= 50m. Calculate the coefficient of permeability of the aquifer. | 7 |
| (c) | Deduce the expression for critical hydraulic gradient. | 5 |

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- (4)(a) Write differences between compaction and consolidation. 5
- (b) What is meant by "zero air void line"? 3
- (c) The results of a laboratory Proctor test are shown here: 4+4=8
- | No. of Test | 1 | 2 | 3 | 4 | 5 | 6 |
|-----------------------------|------|------|------|------|------|------|
| Wt. of mould and Soil (kg.) | 3.53 | 3.71 | 3.78 | 3.95 | 3.92 | 3.89 |
| Water content (%) | 8.34 | 10.7 | 11.9 | 15.3 | 18.3 | 20.5 |
- The mould is 12.7 cm high and has an internal diameter of 10 cm. The weight of empty mould is 1.89 kg.
- i) Plot the moisture content vs. dry density curve and determine optimum moisture content and the maximum dry density.
- ii) Plot the zero air void curve and 15% air void curve. Take $G = 2.68$.
- (d) "The "dry unit weight vs. moisture content" curve initially rises, then falls after attaining a highest value" - explain the reason behind such nature of the curve in perspective of "three phase system" of soil. 4
- (5)(a) State the assumptions of Terzaghi's one dimensional consolidation theory 2
- (b) Derive Terzaghi's one dimensional consolidation theory and also give the expressions for degree of consolidation alongwith neat sketches 6+2 = 8
- (c) An 8 m thick uniform clay stratum is underlain by a 6 m uniformly thick stratum of coarse sand and is followed by an impermeable layer. A raft footing supporting the columns of a building is to be founded at a depth of 1.2 m below ground level. The size of raft is 8.5m x 13.6 m and is uniformly loaded with stress intensity of 9.2 t/ m². The water table is located at 2 m below the ground level. The unit weight of sand above and below water table is 1.8 t/m³ and 2.0 t/m³. 5 + 5 = 10
- The properties of the clay are as follows:
 Initial void ratio: 0.72, Specific gravity of solids = 2.67, liquid limit= 40%, Co-efficient of consolidation = 2.2×10^{-3} cm²/sec.
 Compression index may be obtained using any suitable correlation. Assume 2V:1H dispersion for determining intensity of stress at the centre of the compressible layer.
 Determine: i) Consolidation settlement of the raft,
 ii) The time required to undergo a consolidation settlement of 5 cm.

End of the question