

III B. Tech I Semester Regular Examinations, November- 2015
GEOTECHNICAL ENGINEERING – I
 (Civil Engineering)

Time: 3 hours

Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
 2. Answering the question in **Part-A** is compulsory
 3. Answer any **THREE** Questions from **Part-B**

PART –A

- 1 a) Explain different types of soil structures with neat figures. [3M]
- b) What is a flow curve? Explain with a neat sketch. [4M]
- c) What are the factors affecting permeability? [4M]
- d) What are differences between Bossiness's and Westergaard's theories? [4M]
- e) Define over consolidated, under consolidated and normally consolidated clays. [3M]
- f) Explain the basic mechanism of shear strength of soils. [4M]

PART -B

- 2 a) What is compaction and how it is different from consolidation? [4M]
- b) Explain in detail about three clay minerals. [8M]
- c) One cubic metre of wet soil weighs 19.80 kN. If the specific gravity of soil particles is 2.70 and water content is 11%, find the void ratio, dry density and degree of saturation. [4M]
- 3 a) Define three consistency limits. [3M]
- b) Explain IS soil classification. [8M]
- c) What are the different hydrometer corrections? Explain. [5M]
- 4 a) Derive expression for calculating average permeability of layered soil systems. [8M]
- b) What are the uses of flow nets? [4M]
- c) In order to compute the seepage loss through the foundation of a cofferdam, flownets were constructed. The result of the flownet study gave $N_f = 6$, $N_d = 16$. The head of water lost during seepage was 19.68m. If the hydraulic conductivity of the soil is $k = 13.12 \times 10^{-5}$ m/s, compute the seepage loss per metre length of dam per day. [4M]
- 5 a) Explain Newmark's influence chart preparation and usage. [8M]
- b) Explain 2:1 stress distribution method. [3M]
- c) A ring footing of external diameter 8 m and internal diameter 4 m rests at a depth 2 m below the ground surface. It carries a load intensity 150 kN/m^2 . Find the vertical stress at depths of 2, 4 and 8 m along the axis of the footing below the footing base. Neglect the effect of the excavation on the stress. [5M]

- 6 a) Explain concept of consolidation using Spring Analogy. [5M]
b) Explain the procedure for determining pre consolidated pressure. [5M]
c) An oedometer test is performed on a 2 cm thick clay sample. After 5 minutes, 50% consolidation is reached. After how long time would the same degree of consolidation is achieved in the field where the clay layer is 3.70 m thick? Assume the sample and the clay layers have the same drainage boundary conditions (double drainage). [6M]
- 7 a) Explain Mohr Coulomb's shear failure theory. [4M]
b) Explain three drainage conditions for conducting shear testing of soils. [4M]
c) Given the following data from a consolidated undrained test with pore water pressure measurement, determine the total and effective stress parameters: [8M]
- | | | |
|-------------------------|-----------------------|-------------------------|
| σ_3 | 100 kN/m ² | 200 kN/m ² |
| $(\sigma_1 - \sigma_3)$ | 150 kN/m ² | 192 kN/m ² |
| uf | 60 kN/m ² | 140 kN/m ² . |

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PART -A

- 1 a) What are the effects of compaction on soil properties? [3M]
- b) Explain with neat figure about plasticity chart and label it clearly. [4M]
- c) What quick sand condition? [4M]
- d) What is the use of New mark's influence chart? [3M]
- e) Define initial, primary and secondary consolidation of soils. [4M]
- f) How soils attain their shear strength? [4M]

PART -B

- 2 a) What is compactive effort? [4M]
- b) Write a relationship between void ratio, degree of saturation, unit weight of soil, unit weight of water and specific gravity of soil solids. [6M]
- c) The soil in a borrow pit has a void ratio of 0.90. A fill-in-place volume of 20,000 m³ is to be constructed with an in-place dry density 18.84 kN/m³. If the owner of borrow area is to be compensated at Rs. 1.50 per cubic metre of the excavation, determine the cost of compensation. [6M]
- 3 a) Draw a grain size distribution curves for different grades of soils and name them. [6M]
- b) What are the different Atterberg limits? Explain them. [6M]
- c) The natural moisture content of an excavated soil is 32%. Its liquid limit is 60% and plastic limit is 27%. Determine the plasticity index of the soil and comment about the nature of the soil. [4M]
- 4 a) Derive an equation, for determining soil permeability using variable head permeability test. [8M]
- b) A concrete dam is constructed across a river over a permeable stratum of soil of limited thickness. The water heads are upstream side 16m and 2m on the downstream side. The flow net constructed under the dam gives $N_f = 4$ and $N_d = 12$. Calculate the seepage loss through the subsoil if the average value of the hydraulic conductivity is 6×10^{-3} cm/sec horizontally and 3×10^{-4} cm/ sec vertically. Calculate the exit gradient if the average length of the last field is 0.9 m. Assuming $e = 0.56$, and $G_s = 2.65$, determine the critical gradient. Comment on the stability of the river bed on the downstream side. [8M]

- 5 a) Derive an equation for determining the stress intensity at a given on the axis of loading due to the uniformly loaded circular area. [8M]
b) What is an isobar? What is a pressure bulb? [3M]
c) A ring footing of external diameter 8 m and internal diameter 4 m rests at a depth 2 m below the ground surface. It carries a load intensity 200 kN/m^2 . Find the vertical stress at depths of 2, 4 and 8 m along the axis of the footing below the footing base. Neglect the effect of the excavation on the stress. [5M]
- 6 a) Explain coefficient of volume compressibility, coefficient of consolidation. [6M]
b) How do you determine the consolidated settlement of a foundation? [4M]
c) An oedometer test is performed on a 4 cm thick clay sample. After 5 minutes, 50% consolidation is reached. After how long a time would the same degree of consolidation is achieved in the field where the clay layer is 8 m thick? Assume the sample and the clay layer has the same drainage boundary conditions (double drainage). [6M]
- 7 a) Explain the limitations of shear box test. [4M]
b) Name different lab shear tests on soils. [4M]
c) Given the following data from a consolidated undrained test with pore water pressure measurement, determine the total and effective stress parameters: [8M]
- | | | |
|-------------------------|----------------------|----------------------|
| σ_3 | 100 kN/m^2 | 200 kN/m^2 |
| $(\sigma_1 - \sigma_3)$ | 157 kN/m^2 | 199 kN/m^2 |
| u_f | 57 kN/m^2 | 136 kN/m^2 |

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3. Answer any **THREE** Questions from **Part-B**

PART -A

- 1 a) What is compaction control? Explain. [4M]
- b) Explain C_u , C_c . [4M]
- c) What is Capillarity? Derive an equation to find its rise in soils. [4M]
- d) What is the use of New mark's influence chart? [3M]
- e) What is degree of consolidation and what is it's relation with time factor? [3M]
- f) Explain different drainage conditions for shear testing of soils. [4M]

PART -B

- 2 a) Explain the difference between IS light and heavy compactions. [6M]
- b) Write a relationship between water content, void ration, degree of saturation and specific gravity of soil solids. [4M]
- c) A dry soil has a void ratio of 0.65 and its grain specific gravity is = 2.80. [6M]
 - (i) What is its unit weight?
 - (ii) Water is added to the sample so that its degree of saturation is 60% without any change in void ratio. Determine the water content and unit weight.
 - (iii) The sample is next placed below water. Determine the true unit weight (not considering buoyancy) if the degree of saturation is 95% and 100% respectively.
- 3 a) Show IS soil classification based on grain size. [4M]
- b) Explain Total, neutral and effective stresses. [6M]
- c) The laboratory tests on a sample of soil gave the following results: [6M]
 w_n - 24%, w , = 62%, w_p = 28%, percentage of particles less than 2 microns is- 23%. Determine: (i) The liquidity index, (ii) activity, (iii) consistency and nature of soil.
- 4 a) Derive an equation for quicksand condition. [6M]
- b) Explain Total, Neutral and Effective Stresses. [6M]
- c) In order to compute the seepage loss through the foundation of a cofferdam, flownets were constructed. The result of the flownet study gave N , = 6, Nd = 16. The head of water lost during seepage was 19.68m. If the hydraulic conductivity of the soil is $k = 13.12 \times 10^{-5}$ m/s, compute the seepage loss per metre length of dam per day. [4M]

- 5 a) Explain New mark's influence chart preparation and usage. [8M]
b) What is an isobar? What is a pressure bulb? [3M]
c) A ring footing of external diameter 8 m and internal diameter 4 m rests at a depth 2 m below the ground surface. It carries a load intensity 250 kN/m^2 . Find the vertical stress at depths of 2, 4 and 8 m along the axis of the footing below the footing base. Neglect the effect of the excavation on the stress. [5M]
- 6 a) What are the assumptions in Terzaghi's 1-D Consolidation theory? [6M]
b) Explain consolidation concept. [4M]
c) An oedometer test is performed on a 3 cm thick clay sample. After 5 minutes, 50% consolidation is reached. After how long a time would the same degree of consolidation is achieved in the field where the clay layer is 6 m thick? Assume the sample and the clay layers have the same drainage boundary conditions (double drainage). [6M]
- 7 a) How soils attain their shear strength? [4M]
b) Explain soil strength envelop. [4M]
c) Given the following data from a consolidated undrained test with pore water pressure measurement, determine the total and effective stress parameters: [8M]
- | | | |
|-------------------------|----------------------|----------------------|
| σ_3 | 99 kN/m^2 | 201 kN/m^2 |
| $(\sigma_1 - \sigma_3)$ | 155 kN/m^2 | 197 kN/m^2 |
| uf | 58 kN/m^2 | 138 kN/m^2 |

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PART –A

- 1 a) What are factors that affect compaction? [4M]
- b) Explain C_u, C_c . [4M]
- c) What is quick sand condition? [3M]
- d) What is 2:1 stress distribution method? [4M]
- e) Define coefficient of consolidation and give its relations with other soil parameters. [3M]
- f) Explain different drainage conditions for shear testing of soils. [4M]

PART -B

- 2 a) What are various field compaction methods? [4M]
- b) Write a relationship between void ratio, degree of saturation, unit weight of soil, unit weight of water and specific gravity of soil solids. [6M]
- c) A soil has bulk density of 20.1 kN/m^3 and water content of 15%. Calculate the water content if the soil partially dries to a density of 19.4 kN/m^3 and the void ratio remains unchanged. [6M]
- 3 a) Draw a grain size distribution curves for different grades of soils and name them. [5M]
- b) What are the corrections required in hydrometer analysis? [5M]
- c) The laboratory tests on a sample of soil gave the following results: [6M]
 $w_n = 24\%$, $w_c = 62\%$, $w_p = 28\%$, percentage of particles less than 2 microns is 23%. Determine: (i) The liquidity index, (ii) activity (iii) consistency and nature of soil.
- 4 a) What is capillarity? Derive an equation to find its rise in soils. [4M]
- b) Explain Flow nets, their Characteristics and Uses. [6M]
- c) A concrete dam is constructed across a river over a permeable stratum of soil of limited thickness. The water heads are upstream side 16m and 2 m on the downstream side. The flow net constructed under the dam gives $N_f = 4$ and $N_d = 12$. Calculate the seepage loss through the subsoil if the average value of the hydraulic conductivity is $6 \times 10^{-3} \text{ cm/sec}$ horizontally and $3 \times 10^{-4} \text{ cm/sec}$ vertically. Calculate the exit gradient if the average length of the last field is 0.9 m. Assuming $e = 0.56$, and $G = 2.65$. [6M]

- 5 a) Explain Newmark's influence chart. [8M]
b) What is an isobar? What is a pressure bulb? [3M]
c) A ring footing of external diameter 8 m and internal diameter 4 m rests at a depth 2 m below the ground surface. It carries a load intensity 300 kN/m^2 . Find the vertical stress at depths of 2, 4 and 8 m along the axis of the footing below the footing base. Neglect the effect of the excavation on the stress. [5M]
- 6 a) Explain Compression Index and Swelling Index. [6M]
b) How do you determine the consolidation settlement of a foundation [4M]
c) An oedometer test is performed on a 3 cm thick clay sample. After 5 minutes, 50% consolidation is reached. After how long a time would the same degree of consolidation is achieved in the field where the clay layer is 5 m thick? Assume the sample and the clay layers have the same drainage boundary conditions (double drainage). [6M]
- 7 a) Explain shear box test with neat figure. [8M]
b) Given the following data from a consolidated undrained test with pore water pressure measurement, determine the total and effective stress parameters: [8M]
- | | | |
|-------------------------|----------------------|----------------------|
| σ_3 | 100 kN/m^2 | 200 kN/m^2 |
| $(\sigma_1 - \sigma_3)$ | 156 kN/m^2 | 198 kN/m^2 |
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