

**GUJARAT TECHNOLOGICAL UNIVERSITY****B.E. Sem-V<sup>th</sup> Examination December 2010****Subject code: 150604****Subject Name: Geotechnical Engineering- I****Date: 18 /12 /2010****Time: 03.00 pm - 05.30 pm****Instructions:****Total Marks: 70**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** Define the terms with its importance in civil engineering: **07**
- (i) Coefficient of compressibility
  - (ii) Coefficient of volume compressibility
  - (iii) Coefficient of consolidation
  - (iv) Compression index
- (b)**
- (i)** A saturated clayey soil sample had undergone consolidation under a pressure of 200 kPa in an Oedometer test . The thickness of the specimen was then found to be 21.18 mm and its water content 12%. Subsequently with the further increase in pressure of 100 kPa, the thickness of the specimen at the end of 24 hours was reduced by 1.18 mm. From these data, compute the coefficient of volume compressibility and compression index of the soil assuming  $G=2.7$  **04**
  - (ii)** The time to reach 40% consolidation of two-way drained laboratory 10 mm thick saturated clayey soil sample is 35 seconds. Determine the time required for 60% consolidation of the same soil 10 m thick on the top of rocky surface subjected to the same loading conditions as the laboratory sample. **03**
- Q.2 (a)**
- (i)** With schematic diagram, explain the various shear test apparatuses to determine the shear parameters. Also explain the the various Triaxial tests with regard to its drainage conditions and its field relevance **04**
  - (ii)** A clay specimen has unconfined strength of 100 kPa & is subjected to UU Triaxial test under a cell pressure of 100 kPa. Find its axial stress at failure. **03**
- (b)**
- (i)** In a direct shear test on a specimen of clean, dry sand, a normal stress of 200 kPa was applied and failure occurred at a stress of 140 kPa. Find its angle of shearing resistance **03**
  - (ii)** Three specimens of clay having a small air void content were tested in the shear box. Shear loading was started immediately after the application of normal load and was completed in 10 minutes. The results obtained were as follows: **04**
- |                               |     |     |     |
|-------------------------------|-----|-----|-----|
| Normal stress (kPa)           | 145 | 241 | 337 |
| Shear stress at failure (kPa) | 103 | 117 | 132 |
- Find the apparent cohesion and angle of shearing resistance of the clay.
- OR**
- (b)**
- (i) What is effect of pore water pressure on the strength of a soil mass. **07**
  - (ii) Explain Coulomb's law for shearing strength of soils and its modification by Terzaghi.
  - (iii) Explain Mohr – Coulomb strength envelope.
- Q.3 (a)**
- (i)** What are the various factors that affect the compaction of soil mass in the field? How will you measure the compaction in the field? Describe the methods with its limitations. **03**
  - (ii)** The following data are obtained in a Compaction test: **04**
- |                                 |      |      |      |      |      |      |
|---------------------------------|------|------|------|------|------|------|
| $\gamma_t$ (kN/m <sup>3</sup> ) | 20.2 | 20.8 | 21.7 | 22.0 | 22.1 | 22.0 |
| Moisture content(%)             | 2    | 4.2  | 5.5  | 6.6  | 7.5  | 10.0 |
- Determine OMC & MDD. Draw zero-air void line. Take  $G=2.65$ .

- (b) Calculate the coefficient of permeability of a soil sample, 6 cm in height and  $50 \text{ cm}^2$  in cross sectional area, if a quantity of water equal to 450 ml passed down in 10 minutes under an effective constant head of 40 cm. On oven drying, the test specimen weighs 495 grams. Taking  $G=2.65$ , calculate the seepage velocity of water during the test. **07**

**OR**

- Q.3 (a) (i)** Bring out the usefulness of compaction test in the laboratory in soil engineering practice **03**
- (ii)** By way of neat sketches explain (a) the effect of moisture content on the dry density for a constant compactive effort, (b) effect of compactive effort on the dry density moisture content relationship. **04**
- (b)** In a falling head permeability test on a silty clay sample, the following results were obtained; sample length 120 mm; sample diameter 80 mm ; initial head 1200 mm; final head 400 mm; time for fall in head 6 minutes; stand pipe diameter 4 mm. Find the coefficient of permeability of the soil in mm/second. **07**
- Q.4 (a) (i)** The total unit weight of a soil is  $18.8 \text{ kN/m}^3$ ,  $G = 2.67$ , & moisture content = 12 %. Calculate the dry unit weight, void ratio and the degree of saturation. **03**
- (ii)** Explain the various Field identification test. **04**
- (b) (i)** With schematic diagram, explain single grained structure, honey combed structure and composite structure. **03**
- (ii)** Write a short note on Adsorbed and Structural water. **04**

**OR**

- Q.4 (a)** A soil sample whose water content is 20% has a bulk density of  $21.6 \text{ kN/m}^3$ . The sample undergoes air drying with an insignificant change in the void ratio. What is the water content of this sample when the bulk density is reduced to  $20.0 \text{ kN/m}^3$ . **07**
- (b)** Write a short note on (i) Free water, (ii) Held water, (iii) Sensitivity, and (iv) Thixotropy. **07**
- Q.5 (a) (i)** The liquid limit of a soil is 62 % and its plastic limit is 34 %. Classify the soil as per IS Classification. **03**
- (ii)** Sieve analysis was conducted on a sample of coarse grained soil and the following results were obtained : **04**
- Gravel = 12 % ,  
Sand = 88 %  
 $D_{10} = 0.16 \text{ mm}$   
 $D_{30} = 0.64 \text{ mm}$   
 $D_{60} = 1.22 \text{ mm}$
- Classify the soil as per IS Classification.
- (b)** Granular soil deposit is 7 m deep over an impermeable layer. The ground water table is 4 m below the ground surface. The deposit has a zone of capillary rise of 1.2 m with a saturation of 50 %. Plot the variation of total stress, pore water pressure and effective stress with the depth of deposit. Take,  $e = 0.6$  and  $G = 2.65$ . **07**

**OR**

- Q.5 (a) (i)** Draw the Phase diagram for a soil mass having ;- **03**
- (a) Degree of saturation = 60 %  
(b) Void ratio = 40 %  
(c) Water content = 30 %  
(d) Saturated unit weight =  $1.5 \text{ g/cc}$
- (ii)** Write a short note on sedimentation analysis for particle size distribution **04**
- (b) (i)** The liquid limit and plastic limit of a soil sample are 65 % and 29 % respectively. The percentage of soil fraction with grain size finer than 0.002 mm is 24. Calculate the activity ratio of the soil sample **03**
- (ii)** The Atterburg limits of a clay are 38 %, 27 %, and 24.5 %. Its natural water content is 30 %. What is the state of the clay. **04**

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