

**III B.Tech I Semester Supplementary Examinations, May- 2019****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**
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**PART –A**

- 1
  - a) What are the different types of soil structures which can occur in nature? [3M]
  - b) Explain with neat sketch, the concept of total, effective and neutral pressure in soils. [4M]
  - c) What are the factors that affect permeability? [4M]
  - d) Define Consistency Limits? Why they are required to find in geotechnical Engineering? [3M]
  - e) Discuss the spring analogy for primary consolidation. [4M]
  - f) Draw the Mohr's circle for unconsolidated undrained test and explain about its failure envelop. [4M]

**PART -B**

- 2
  - a) From the fundamental definitions, derive the relation between bulk unit weight of the soil,  $\gamma$ , specific gravity of soil solids,  $G$ , void ratio,  $e$ , water content,  $w$ , and unit weight of the water,  $\gamma_w$ . [8M]
  - b) From the light compaction test on a soil sample are give below. [8M]
 

Mass (g)	1680	1810	2010	2000	1890	1820
Water Content (%)	8.0	10.5	12.6	14.8	18.2	20.7

The volume of the mould is 945 cc. Draw the compaction curve and find out maximum dry density and optimum moisture content. Draw 96 % saturation line.

- 3
  - a) The following data relate to five samples. [8M]
 

Liquid limit, LL (%) 25 45 50 60 80  
 Plastic limit, PL (%) 15 23 25 35 36

Plot these on Casagrande's A line chart and Classify these soils.
  - b) For a gravel with  $D_{60} = 4.8$  mm,  $D_{30} = 1.25$ mm and  $D_{10} = 0.35$  mm, calculate the uniformity coefficient and coefficient of curvature. Is it a well graded or a poorly graded soil? [8M]
- 4
  - a) Derive the relation between the superficial velocities of flow to the seepage velocity of the flow. [8M]
  - b) From the flow net diagram drawn for seepage flow through an earth dam the flowing data is obtained. Compute the seepage through the body of the dam per unit length. Number of flow lines =  $N_f = 3.5$ . Number of equi-potential drops = 10. Coefficient of permeability =  $1.25 \times 10^{-5}$  cm/sec. head causing seepage flow,  $h = 12.5$  m. [8M]

- 5 a) Briefly explain the construction of Newmark's Influence Chart and briefly explain its usage? [8M]
- b) A monument 5000 kN is erected on the ground surface. Considering the load as concentrated, determine the vertical pressure directly under the monument at a depth of 10m below the ground surface. Also calculate the vertical pressure at a point, which is at a deputation of 10 m and a horizontal distance of 5m from the axis of the load. [8M]
- 6 a) Describe briefly the procedure to compute the pre-consolidation pressure [8M]
- b) An oedometer test is performed on a 2 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 3.7 m thick? Assume the sample and the clay layer has the same drainage boundary conditions (double drainage). [8M]
- 7 a) Describe the direct shear test. What are its merits and demerits compared to Tri-axial test. [8M]
- b) Two identical specimens of soil were tested in a tri-axial apparatus. The first specimen failed at a deviator stress of  $800 \text{ kN/m}^2$  when the cell pressure was  $200 \text{ kN/m}^2$  while the second specimen failed at a deviator stress of  $1400 \text{ kN/m}^2$  when the sell pressure was  $300 \text{ kN/m}^2$ . Determine 'c' and ' $\phi$ ' for the soil. [8M]

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## III B. Tech I Semester Supplementary Examinations, October/November -2018

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- 1 a) Explain the compaction curve. [4M]
- b) Draw the gradation curves separately of a well graded soil and gap graded soil. [4M]
- c) Explain quick sand condition. [3M]
- d) What is the purpose of a Newmark's chart? [4M]
- e) Write the relationship between the time factor and degree of consolidation, when the degree of consolidation is greater than 60%? [4M]
- f) How is the torque determined in a vane shear test? [3M]

**PART -B**

- 2 a) Write a note on clay minerals. [6M]
- b) The moist unit weight of a soil is  $16.50 \text{ kN/m}^3$ . Given that the water content = 15% and specific gravity of soil solids = 2.70, find the dry unit weight, porosity, degree of saturation the mass of water that must be added to reach full saturation. [10M]
- 3 a) Explain the consistency limits. [6M]
- b) A certain soil has 99% by weight finer than 1.0mm, 80% finer than 0.10mm, 25% finer than 0.01mm, 8% finer than 0.001mm. Sketch the grain-size distribution curve and determine the percentage of sand, silt and clay fractions as per IS nomenclature. [10M]
- 4 a) What are the characteristics and uses of flow nets? [8M]
- b) The discharge of water collected from a constant head permeameter in a period of 15 minutes is 400ml. The internal diameter of the permeameter is 6.0cm and the measured difference in heads between the two gauging points 15.0cm apart is 40.0cm. Calculate the coefficient of permeability? [8M]
- 5 a) Explain in detail the construction of Newmark's chart with an influence value of 0.002. [8M]
- b) A ring foundation is of 3.0 m external diameter and 2.0 m internal diameter. It transmits a uniform pressure of  $90.0 \text{ kN/m}^2$ . Calculate the vertical stress at a depth of 1.50 m directly beneath the centre of the loaded area. [8M]

- 6 a) Define pre consolidation pressure. Describe a suitable procedure for determining the pre consolidation pressure. [8M]
- b) A clay layer 5.0m thick has double drainage. It was consolidated under a load of  $127.50 \text{ kN/m}^2$ . The load is increased to  $197.50 \text{ kN/m}^2$ . The coefficient of volume compressibility is  $5.79 \times 10^{-4} \text{ m}^2/\text{kN}$  and value of  $k = 1.60 \times 10^{-8} \text{ m/min}$ . If the test sample is 2cm thick and attains 100% consolidation in 24 hours, what is the time taken for 100% consolidation in the actual layer? [8M]
- 7 a) Explain the shear characteristics of sand and normally loaded clays? [8M]
- b) The following results were obtained from a direct shear test on a sandy clay sample. [8M]

Normal load (N)	Shear load providing ring reading (division)
360	13
720	19
1080	26
1440	26

If the shear box is 60 mm square and the proving ring constant is 20 N per division, estimate the shear strength parameters of the soil. Would failure occur on a plane within this soil at a point where the normal stress is  $320 \text{ kN/m}^2$  and the corresponding shear stress is  $138 \text{ kN/m}^2$ ?

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**PART –A**

- 1 a) Define texture of a soil. [3M]
- b) Write the equation of the A-line, and explain the terms in it. [4M]
- c) What is an equipotential line and a flow line? [4M]
- d) A point load of 100 kN is applied at the ground surface. What is the value of vertical stress at a depth of 3 m and 2 m radially from the point of application? [4M]
- e) Write the relationship between coefficient of permeability, coefficient of consolidation and unit weight of water. [3M]
- f) Define critical void ratio. [4M]

**PART –B**

- 2 a) Derive the relationship between bulk density, degree of saturation and void ratio of a soil. [8M]
- b) A dry soil has a void ratio of 0.65 and its grain specific gravity is  $= 2.80$ . What is its unit weight? 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. 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. [8M]
- 3 a) Explain the procedure to conduct the hydrometer test on a soil sample in the lab. [8M]
- b) Dry soil with  $G = 2.71$  is mixed with 16% by weight of water and compacted to produce a cylindrical sample of 38 mm diameter and 76mm long with 6% air content. Calculate the mass of the mixed soil that will be required and the void ratio of the sample. [8M]
- 4 a) Derive the expression to determine the capillary rise in a soil deposit. [8M]
- b) A uniform soil deposit has a void ratio 0.60 and specific gravity of 2.65. The natural ground water is at 2.50 m below natural ground level. Due to capillary moisture, the average degree of saturation above ground water table is 50%. Determine the neutral pressure, total pressure and effective pressure at a depth of 6.0 m. Draw a neat sketch. [8M]
- 5 a) Compare and contrast Boussinesq's and Westergaard's theories? [8M]
- b) A strip load of considerable length and 1.50 m width transmits a pressure of  $150 \text{ kN/m}^2$  to the underlying soil. Determine the maximum principal stress at 0.75 m depth below the footing, if the point lies (i) directly below the centre of the footing, and (ii) directly below the edge of the footing. [8M]

- 6 a) Explain the Spring Analogy concept of consolidation, with neat sketches? [8M]  
 b) The void ratio of clay A decreased from 0.572 to 0.505 under a change in pressure from 1.20 kPa to 1.80 kPa. The void ratio of clay B decreased from 0.612 to 0.597 under the same increment of pressure. The thickness of sample A was 1.50 times that of B. Nevertheless the time required for 50% consolidation was three times longer for sample B than for sample A. What is the ratio of the coefficient of permeability of A to that of B? [8M]
- 7 a) Explain the three standard triaxial shear tests with respect to drainage conditions? [8M]  
 b) The following data relate to a triaxial compression tests performed on a soil sample: [8M]

Test No.	Chamber pressure (kPa)	Maximum deviator stress (kPa)	Pore pressure at maximum deviator stress (kPa)
1.	80	175	45
2.	150	240	50
3.	210	300	60

Determine the effective shear strength parameters of the soil, **graphically only**.

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**PART -A**

- 1 a) Define the functional relationship between  $e$ ,  $S$ , &  $n_a$ ? [3M]
- b) Give a short note on unified soil classification system.. [4M]
- c) Explain about poiseville's law? [4M]
- d) Define stress isobar. [3M]
- e) Explain how the consolidation settlement is done by using voids ratio? [4M]
- f) Discuss about triaxial shear test. [4M]

**PART -B**

- 2 a) A soil sample has a porosity of 30% the specific gravity of solids is 2.60. Calculate (a) void ratio, (b) dry density (c) unit weight if the soil is 50% saturated and (d) unit weight if the soil is completely saturated. [4M]
- b) Explain various types of field compaction control. [8M]
- c) Determine the field density of a natural soil by using core cutter method. [4M]
- 3 a) In order to determine the water content 350 gms of wet sandy sample was placed in a pycnometer the mass of the pycnometer, sand and water full to the top of the conical cap was found to be 2350 gms the mass of the pycnometer full of clean water was 2000 gms. Taking  $G = 2.75$ , determine the water content of the sample? [4M]
- b) Explain the classification of soils by textural classification system. [8M]
- c) Write a short note on pipette method. [4M]
- 4 a) Explain how the capillarity and permeability test is conducted. Describe briefly. [8M]
- b) Evaluate the flow net construction is done by graphical method. [8M]
- 5 a) Explain how the vertical pressure determined due to strip load? [8M]
- b) Derive an expression of vertical stress for normal load over a circular area. [8M]
- 6 a) Explain the consolidation process by spring analogy. [8M]

- b) Two clay specimens A and B, of thickness of 2cm and 3cm, have equilibrium voids ratios 0.68 and 0.72 respectively under a pressure of  $200 \text{ kN/m}^2$ . If the equilibrium void ratios of two soils reduced to 0.5 and 0.62 respectively. When the pressure was increased to  $400 \text{ kN/m}^2$ , find the ratio of the coefficient of permeability of the two specimens. The time required by the specimen A to reach 40 percent degree of consolidation  $\frac{1}{4}$  is of that required by specimen B for reaching 40 percent degree of consolidation? [8M]
- 7 a) Explain briefly about the Mohr's stress circle. [8M]
- b) Find an expression for the unconfined compressive strength  $q_u$  in terms of  $c'$ ,  $\phi'$  and  $A_f$  (pore pressure parameter at failure). Take parameter  $B=1$  and initial capillary tension  $= \mu_c$ ? [8M]

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**PART -A**

- 1 a) Define the functional relationship between  $\gamma, G, e, S?$  [3M]
- b) Write salient features of plasticity chart. [4M]
- c) Explain how determination of seepage pressure is done? [4M]
- d) Determine the vertical pressure distribution on horizontal plane. [3M]
- e) Define coefficient of volume change. [4M]
- f) Discuss about vane shear test. [4M]

**PART -B**

- 2 a) A soil sample has a porosity of 60% the specific gravity of solids is 2.40. [4M]  
 Calculate (a) void ratio, (b) dry density (c) unit weight if the soil is 50% saturated and (d) unit weight if the soil is completely saturated.
- b) Explain briefly about the effect of compaction on soil properties? [8M]
- c) Determine the field density of a natural soil by using rubber balloon method? [4M]
- 3 a) In order to determine the water content 385 gm of wet sandy sample was [4M]  
 placed in a pycnometer the mass of the pycnometer, sand and water full to the top of the conical cap was found to be 2450 gm the mass of the pycnometer full of clean water was 1870 gm. Taking  $G = 2.55$ , determine the water content of the sample?
- b) Explain the classification of soils by US classification system? [8M]
- c) Write a short note on particle size distribution curve? [4M]
- 4 a) Explain how the preatic line of an earth dam by using casagrande method. [8M]
- b) Discuss briefly about falling head permeability test. [8M]
- 5 a) Write a short note on westergaard's analysis. [8M]
- b) Derive an expression of vertical stress for triangular, uniformly distributed strip [8M]  
 load of finite width and trapezoidal loading.
- 6 a) Distinguish the consolidation process of undisturbed specimen. [8M]

- b) Two clay specimens A and B, of thickness of 2.5cm and 3.5cm, have equilibrium voids ratios 0.65 and 0.75 respectively under a pressure of  $250\text{kN/m}^2$ . If the equilibrium void ratios of two soils reduced to 0.57 and 0.71 respectively. When the pressure was increased to  $450\text{ kN/m}^2$ , find the ratio of the coefficient of permeability of the two specimens. The time required by the specimen A to reach 50 percent degree of consolidation  $\frac{1}{4}$  is of that required by specimen B for reaching 50 percent degree of consolidation? [8M]
- 7 a) Explain briefly about the Mohr's Coulomb failure theory. [8M]
- b) A vane, 10cm long and 8 cm in diameter, was pressed into soft clay at the bottom of a bore hole torque was applied and gradually increased to 45N-m when failure took place. Subsequently, the vane rotated rapidly so as to completely remould the soil. The remoulded soil was sheared at a torque of 18N-m. Calculate the cohesion of the clay in the natural and remoulded state and also the value of the sensitivity? [8M]

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**PART -A**

- 1 a) Define the functional relationship between  $e$ ,  $G$ ,  $w$  &  $S$ . [3M]
- b) Define consistency index and liquidity index. [4M]
- c) Explain the relationship between discharge velocity & seepage velocity. [4M]
- d) What are the assumptions made by theory of elasticity? [3M]
- e) Explain how the consolidation settlement is done by using coefficient of volume change? [4M]
- f) Discuss about direct shear test. [4M]

**PART -B**

- 2 a) A soil sample has a porosity of 40%. The specific gravity of solids is 2.70. Calculate (a) Void ratio (b) dry density (c) unit weight if the soil is completely saturated. [4M]
- b) Explain different types of field compaction methods. [8M]
- c) Determine the field density of a natural soil by using sand replacement method. [4M]
- 3 a) In order to determine the water content 370 gm of a wet sandy sample was placed in a pycnometer. The mass of the pycnometer, sand and water full to the top of the conical cap was found to be 2148gm. The mass of pycnometer full of clean water was 1932gm taking  $G=2.65$  Determine the water content of the sample. [4M]
- b) Explain the classification of soils by IS classification system. [8M]
- c) Write a short note on sedimentation analysis. [4M]
- 4 a) What are the factors affecting permeability? [8M]
- b) Explain how the preatic line is determined in an earth dam with no filter.? [8M]
- 5 a) Explain how the vertical pressure determined due to line load? [8M]
- b) Derive an expression of stress distribution for uniform vertical load over a strip. [8M]
- 6 a) Distinguish the consolidation of laterally confined soil. [8M]

- b) Two clay specimens A and B, of thickness of 1.8cm and 2.8cm, have [8M]  
equilibrium voids ratios 0.63 and 0.70 respectively under a pressure of  $280 \text{ kN/m}^2$ . If the equilibrium void ratios of two soils reduced to 0.53 and 0.68 respectively. When the pressure was increased to  $380 \text{ kN/m}^2$ , find the ratio of the coefficient of permeability of the two specimens. The time required by the specimen A to reach 40 percent degree of consolidation  $\frac{1}{4}$  is of that required by specimen B for reaching 40 percent degree of consolidation?
- 7 a) Explain briefly about the effective stress principle. [8M]
- b) A vane, 12cm long and 6 cm in diameter, was pressed into soft clay at the [8M]  
bottom of a bore hole torque was applied and gradually increased to 50N-m when failure took place. Subsequently, the vane rotated rapidly so as to completely remould the soil. The remoulded soil was sheared at a torque of 25N-m. Calculate the cohesion of the clay in the natural and remoulded state and also the value of the sensitivity?

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**PART –A**

- 1 a) Define the functional relationship between  $\gamma_d$ ,  $G$ , &  $e$ . [3M]
- b) What do you understand by grain size distribution? Briefly explain. [3M]
- c) Explain how to determine exit gradient? [4M]
- d) Determine the vertical pressure distribution along a vertical line. [4M]
- e) Define coefficient of compressibility. [4M]
- f) Discuss about unconfined compression test. [4M]

**PART -B**

- 2 a) A soil sample has a porosity of 50%. The specific gravity of solids is 2.80. Calculate (a) Void ratio (b) dry density (c) unit weight if the soil is completely saturated. [4M]
- b) What are the factors affecting compaction. Explain briefly? [8M]
- c) Determine the field density of a natural soil by using water displacement method? [4M]
- 3 a) In order to determine the water content 360 gm of a wet sandy sample was placed in a pycnometer. The mass of the pycnometer, sand & water full to the top of the conical cap was found to be 2250gm. The mass of pycnometer full of clean water was 2031gm, taking  $G=2.85$ . Determine the water content of the sample? [4M]
- b) Explain the classification of soils by HRB classification system. [8M]
- c) Write a short note on Hydrometer method. [4M]
- 4 a) Determine the seepage through Anisotropic soil. Explain briefly. [8M]
- b) Explain how the constant head permeability test is conducted? [8M]
- 5 a) Explain about New mark's influence chart? [8M]
- b) Derive an expression of vertical stress for triangularly distributed and symmetrically distributed triangular load? [8M]
- 6 a) Explain Terzaghi's theory of one dimensional consolidation. [8M]

- b) Two clay specimens A and B, of thickness of 3cm and 4cm, have equilibrium voids ratios 0.55 and 0.61 respectively under a pressure of  $300\text{kN/m}^2$ . If the equilibrium void ratios of two soils reduced to 0.45 and 0.51 respectively. When the pressure was increased to  $500\text{ kN/m}^2$ , find the ratio of the coefficient of permeability of the two specimens. The time required by the specimen A to reach 45 percent degree of consolidation  $\frac{1}{4}$  is of that required by specimen B for reaching 45 percent degree of consolidation? [8M]
- 7 a) Explain briefly about the skempton's pore pressure. [8M]
- b) A vane, 17cm long and 9 cm in diameter, was pressed into soft clay at the bottom of a bore hole torque was applied and gradually increased to 65N-m when failure took place. Subsequently, the vane rotated rapidly so as to completely remould the soil. The remoulded soil was sheared at a torque of 33N-m. Calculate the cohesion of the clay in the natural and remoulded state and also the value of the sensitivity? [8M]

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- 6 a) Discuss the spring analogy for primary consolidation. [6M]  
b) Describe log time fitting method. [6M]  
c) Define coefficient of compressibility and compression index. [4M]
- 7 a) What are the various drainage conditions and what is the significance of each drainage conditions? [8M]  
b) Describe direct shear test. What are its merits and demerits? [8M]

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**PART –A**

- 1 a) List any two types of field compaction equipment. Also list any two types of soil structures [4M]
- b) What are the corrections to be applied to hydrometer test readings [3M]
- c) Write the formula to determine height of capillary rise in a soil and mention what each term of the formula stands for? [4M]
- d) What is an Isobar? [3M]
- e) Define normally consolidated clay? Write the formula to determine the compression index in terms of liquid limit. [3M]
- f) Define shear strength of a soil. What are the names of shear tests based on drainage conditions? [5M]

**PART -B**

- 2 a) Write short notes on texture and structure of soils. [8M]
- b) Explain about transported soils and soil formation. [8M]
- 3 a) What are the limitations of hydrometer test? [8M]
- b) The following results were recorded in a shrinkage limit test using mercury [8M]
 

|                                    |                       |
|------------------------------------|-----------------------|
| Mass of container                  | =17.0g                |
| Mass of wet soil and container     | =72.30g               |
| Mass of dish                       | =132.40g              |
| Mass of dish and displaced mercury | =486.10g              |
| Mass of dry soil and container     | =58.20g               |
| Volume of wet soil                 | =32.4 cm <sup>3</sup> |

Determine the shrinkage limit, the linear shrinkage and the shrinkage ratio. The density of mercury is 13.6g/cm<sup>3</sup>.
- 4 a) Write notes on soil water [8M]
- b) A falling head permeability test is to be performed on a soil sample whose coefficient of permeability is  $3 \times 10^{-5}$  cm/s. What diameter of the standpipe should be used if the head is to drop from 27.5cm to 20.0cm in 5 minutes and if the cross-sectional area and length of the sample are respectively 15cm<sup>2</sup> and 8.5cm? [8M]

- 5 a) With a sketch explain the construction of a Newmark's chart? [8M]  
 b) i) A long strip footing of width 2m transmits a pressure of 200kPa to the underlying soil. Using 2 : 1 dispersion method, compute the approximate value of the vertical stress at a depth of 5m below the footing. [8M]  
 ii) A line load of 100kN/m run extends to a long distance. Determine the intensity of vertical stress at a point 2m below the surface at a distance of 2m perpendicular to the line load. Use Boussinesq's theory
- 6 a) Explain briefly the laboratory consolidation test [8M]  
 b) In a consolidation test the pressure on a sample was increased from 150 to 300kN/m<sup>2</sup>. The void ratio after 100% consolidation under 150kN/m<sup>2</sup> was 0.945, and that under 300kN/m<sup>2</sup> was 0.812. The coefficient of permeability of the soil was 25 x 10<sup>-6</sup> mm/s and the initial height of the sample was 20mm. Determine (i) the coefficient of compressibility, (ii) the coefficient of volume compressibility [8M]
- 7 a) Write a note on the laboratory box shear test. [8M]  
 b) The following results were obtained from a triaxial test on two soil specimens. [8M]

| Sample No. | Confining Pressure(kPa) | Deviator Stress at failure(kPa) | Pore water pressure(kPa) |
|------------|-------------------------|---------------------------------|--------------------------|
| 1          | 200                     | 244                             | 55                       |
| 2          | 300                     | 314                             | 107                      |

Determine the shear strength parameters of the soil terms of (i) total stresses  
 ii) effective stresses

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**PART -A**

- 1 a) List the names of three important clay minerals [3M]
- b) Define a sand particle as per IS classification system. Write the formula to determine the coefficient of uniformity of a soil. [4M]
- c) Write the relationship between discharge velocity and seepage velocity and also state Darcy's law [3M]
- d) List the assumptions of Boussinesq's theory [4M]
- e) Write Terzaghi's one-dimensional consolidation equation and mention what each term of the formula stands for. [4M]
- f) What is the name of the test used to determine quickly the un drained shear strength of soft clay? Write the formula to determine the sensitivity of a clay. [4M]

**PART -B**

- 2 a) What are the two basic structural units of clay minerals? Explain them [8M]
- b) Write a short note about diffuse double layer and base exchange capacity. [8M]
- 3 a) What is meant by consistency of soils? Define all the Atterberg limits [8M]
- b) The following data refer to a sample of soil: [8M]  
 Percent passing 4.75 mm IS Sieve = 64  
 Percent passing 75-μ IS Sieve = 6,  
 Uniformity Coefficient = 7.5  
 Coefficient of Curvature = 2.7, Plasticity index = 2.5%  
 Classify the soil as per IS soil classification.
- 4 a) Derive the formula to compute the height of capillary rise in soils. [8M]
- b) Determine the average horizontal and vertical permeability coefficients of a soil deposit made up of three horizontal strata, each 1m thick, if the coefficients of permeability are  $1 \times 10^{-1}$  mm/s,  $3 \times 10^{-2}$  mm/s and  $8 \times 10^{-3}$  mm/s respectively for the three layers. [8M]
- 5 a) Write a note on 2:1 stress distribution method. [8M]
- b) A ring foundation of 10m external diameter and 9m internal diameter carries a uniformly distributed load of 150kPa. Determine the vertical stress due to the load at a depth of 6m below the centre of the foundation. [8M]

- 6 a) Explain Casagrande's method to determine the coefficient of consolidation [8M]  
 b) In a consolidation test the pressure on a sample was increased from 140 to 280kN/m<sup>2</sup>. The void ratio after 100% consolidation under 140kN/m<sup>2</sup> was 0.95, and that under 280kN/m<sup>2</sup> was 0.82. The coefficient of permeability of the soil was  $20 \times 10^{-6}$  mm/s and the initial height of the sample was 20mm. Determine (i) the coefficient of consolidation, and (ii) the time taken in days for 90% consolidation of the layer of this clay, 0.5mm thick in the field, sandwiched between an impervious layer beneath and the pervious layer on top. [8M]
- 7 a) Write a note on the laboratory triaxial shear test. [8M]  
 b) The following results were obtained from a direct shear test on a sandy clay sample. [8M]

Normal load (N)	Shear load proving ring reading (divisions)
360	13
720	19
1080	26
1440	26

If the shear box is 60mm square and the proving ring constant is 20N per division, estimate the shear strength parameters of the soil. Would failure occur on a plane within this soil at a point where the normal stress is 320kN/m<sup>2</sup> and the corresponding shear stress is 138kN/m<sup>2</sup>?

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**III B. Tech I Semester Regular/Supplementary Examinations, October/November - 2016**  
**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**

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**PART -A**

- 1 a) Define degree of compaction. What is zero air voids line and its significance [4M]
- b) Define a gap graded soil. Also write the equation of the A-line and mention what each term of the equation stands for. [5M]
- c) What is quick sand condition? [3M]
- d) When is Newmark's influence chart applicable? What are the differences between Boussinesq's and Westergaard's theories [4M]
- e) List the two methods used for finding the coefficient of consolidation. [3M]
- f) Define Critical Void Ratio and explain in which state sand can have cohesion. [3M]

**PART -B**

- 2 a) Derive the relationship between bulk unit weight of a soil, specific gravity and degree of saturation. [8M]
- b) Write about the factors affecting the compaction properties of a soil. [8M]
- 3 a) Write a short note on the corrections to be applied to hydrometer test readings [6M]
- b) The undisturbed soil at a pit has a water content of 15%, void ratio 0.60 and specific gravity of 2.70. The soil from the pit is to be used to construct a rolled fill having a finished volume of 35000m<sup>3</sup>. The soil is to be transported from the pit to the construction site by trucks having a net carrying capacity of 6tons. After completion, the fill soil has a water content of 18% and dry density of 1.70 g/cm<sup>3</sup>. Calculate the total number of trips the truck will have to make to construct the rolled fill. [10M]
- 4 a) With the help of a sketch of a flow net, derive the formula to determine the quantity of seepage through an earth dam. [8M]
- b) A soil profile consists of a surface layer of sand 3m thick ( $\gamma=16\text{kN/m}^3$ ), an intermediate clay layer 2m thick ( $\gamma_{\text{sat}}=19.25\text{kN/m}^3$ ), and a bottom layer of gravel 4m thick ( $\gamma_{\text{sat}}=19\text{kN/m}^3$ ). The water table is at the top of the clay layer. Determine the effective stress at various interfaces. There is a surcharge of 50kN/m<sup>2</sup> on the ground surface. [8M]

- 5 a) With a sketch explain the construction of a Newmark's chart? [8M]  
b) Two point loads P and Q act on the ground surface 8m apart. The magnitude of P is 100kN and that of Q is 80kN. Point A is at a depth of 6m directly below P and point B is at a depth of 5m directly below Q. Point C is between P and Q and it is at a distance of 4m from P. Point C lies at a depth of 3m below the ground surface. Calculate the increase in vertical stresses at A, B and C due to the point loads. [8M]
- 6 a) Explain Taylor's method to determine the coefficient of consolidation [8M]  
b) A consolidation test was performed on a 20mm thick undisturbed clay sample. 50% consolidation occurred in 5 minutes. The sample was drained both at the top and at the bottom. In the field, the clay layer is 2.4m thick and is underlain by an impervious rock. Drainage is possible only at the top surface. (i) Determine the coefficient of consolidation and (ii) calculate the time in days for 50% and 90% consolidation to take place in the field deposit. [8M]
- 7 a) Explain the shear characteristics of sand? [8M]  
b) In an unconfined compression test, a sample of sandy clay 8cm long and 4cm in diameter fails under a load of 120N at 10% strain. Compute the shearing resistance taking into account the effect of change in cross-section of the sample. [8M]

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**III B. Tech I Semester Regular/Supplementary Examinations, October/November - 2016**  
**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**

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**PART -A**

- 1 a) List any four factors affecting the compaction of a soil [4M]
- b) Define consistency of a soil and liquid limit of soil [4M]
- c) Define equipotential line. What is the name of the topmost flow line of an earth dam [3M]
- d) What is the increase in vertical stress at a point 5m below a point load of 100kN, using Boussinesq's theory? [3M]
- e) Write the formula to determine the time factor, when the degree of consolidation is more than 60%. Define over-consolidation ratio [4M]
- f) What is usual length to diameter ratio of a lab triaxial test sample? What is the formula of additional axial stress and what is another name for additional axial stress [4M]

**PART -B**

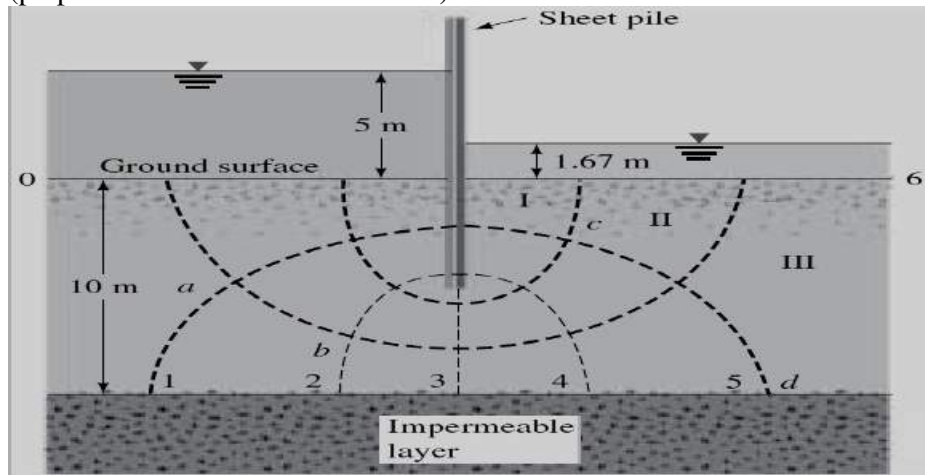
- 2 a) Write a short note on adsorbed water and relative density. [8M]
- b) How is compaction control achieved in the field? [8M]
- 3 a) Draw neatly the IS plasticity chart and label it. [8M]
- b) In a hydrometer test, the initial reading is 1.08. After one hour, the corrected hydrometer reading is 1.03 and the corresponding effective depth is 12cm. Find the initial weight of soil placed in 1000cc suspension, the particle size corresponding to the 15min reading, and the percentage of particles finer than this size. Take  $G = 2.65$ , and  $\mu = 0.1$  poise. [8M]
- 4 a) Derive the expression to determine the average coefficient of permeability in the horizontal direction for a stratified soil deposit. [8M]

- b) A flow net for flow around a single row of sheet piles in a permeable soil layer is shown in Figure. Given that [8M]

$$k_x = k_z = k = 5 \times 10^{-3} \text{ cm/s}$$

i) How high (above the ground surface) will the water rise, if piezometers are placed at points **a** and **d**?

ii) What is the rate of seepage through flow channel II per unit length (perpendicular to the section shown)?



- 5 a) Write a note on 2:1 stress distribution method [6M]  
 b) A three-legged tower forms an equilateral triangle of side 4m in plan. If the total weight of the tower is 450kN and is equally carried by all the legs, compute the vertical stress increase caused in the soil by the tower at a depth of 4m directly below one of the legs and also at the same depth below the centroid of the triangle. [10M]
- 6 a) Describe Casagrande's method of geometrical construction to find the pre-consolidation pressure. [8M]  
 b) The settlement analysis of a proposed structure indicated that 5cm of settlement will occur in three years and the total settlement will be 150mm. The analysis was based on the assumption that the compressible layer is drained only at the top surface. However further investigations showed that there will be drainage both at the bottom and the top of the layer. For the case of double drainage, calculate (i) ultimate total settlement, (ii) time required for 50mm of settlement. [8M]
- 7 a) Explain the stress-strain behaviour of clays. [8M]  
 b) In a direct shear test on a specimen of clean dry sand, a normal stress of 180kPa was applied and failure occurred at a shear stress of 100kPa. Determine analytically the angle of shearing resistance, the principal stresses during failure, and directions of the principal planes with respect to the direction of the plane of shearing. [8M]

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**III B. Tech I Semester Supplementary Examinations, May - 2016**  
**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**

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**PART –A**

- 1 a) What is zero air void line? [4M]
- b) Define plasticity index. What is its importance? [3M]
- c) State the different modes of soil water. [4M]
- d) What are the assumptions made by Boussinesq's in deriving the expression for stress in soil due to a point load on the ground surface? [4M]
- e) Briefly explain e-p and e-log p curves. [4M]
- f) What is critical void ratio? On which factor does it depend? [3M]

**PART –B**

- 2 a) Explain the Effect of compaction on soil properties. [8M]
- b) Describe the formation of soil due to mechanical weathering. [4M]
- c) How compaction of soil is controlled in field? [4M]
- 3 a) What is the use of classification of soils? Discuss Indian standard classification system? [8M]
- b) What are the different soil indices used in identification of soil? Describe each one. Give their uses. [8M]
- 4 a) A soil strata consists of 3 layers of thickness 1m, 1.5m and 2.0 m having the co-efficient of permeability of  $2 \times 10^{-3}$  cm/s,  $1.5 \times 10^{-3}$  cm/s and  $3 \times 10^{-3}$  cm/s respectively. Estimate the average co-efficient of permeability in the direction i) parallel to the bedding plane ii) normal to the bedding plane. [8M]
- b) Derive an expression to determine coefficient of permeability of soil by laboratory falling head permeability test. [8M]
- 5 A rectangular area of 2m x 4m carries a uniformly distributed load 80 kN/sq.m at ground surface. Find the vertical pressure at 5m below the centre and corner of the loaded area. Solve the problem by a) dividing the rectangle into four equivalent rectangles, b) 2:1 method. [16M]
- 6 a) Discuss Terzaghi's theory of consolidation by stating the various assumptions and its validity. [7M]
- b) Describe square root time fitting method. [6M]
- c) Define coefficient of compressibility and coefficient of volume change. [3M]

1 of 2

- 7 a) Sketch stress strain diagrams for loose sand, dense sand, soft clay and stiff clay [10M]  
and comment.
- b) When do you use the following shear tests and give reasons: [6M]  
(a) shear box;  
(b) vane shear test;  
(c) unconfined compression test .

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**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**

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**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  $150 \text{ kN/m}^2$ . 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]
- |                         |                       |                         |
|-------------------------|-----------------------|-------------------------|
| $\sigma_3$              | 100 kN/m <sup>2</sup> | 200 kN/m <sup>2</sup>   |
| $(\sigma_1 - \sigma_3)$ | 150 kN/m <sup>2</sup> | 192 kN/m <sup>2</sup>   |
| $u_f$                   | 60 kN/m <sup>2</sup>  | 140 kN/m <sup>2</sup> . |

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**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**

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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 m<sup>3</sup> is to be constructed with an in-place dry density 18.84 kN/m<sup>3</sup>. 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  $6 \times 10^{-3}$  cm/sec horizontally and  $3 \times 10^{-4}$  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  $200 \text{ kN/m}^2$ . 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]
- |                         |                      |                      |
|-------------------------|----------------------|----------------------|
| $\sigma_3$              | $100 \text{ kN/m}^2$ | $200 \text{ kN/m}^2$ |
| $(\sigma_1 - \sigma_3)$ | $157 \text{ kN/m}^2$ | $199 \text{ kN/m}^2$ |
| $u_f$                   | $57 \text{ kN/m}^2$  | $136 \text{ kN/m}^2$ |

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**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**

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**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  $N = 6$ ,  $N_d = 16$ . 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 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  $250 \text{ kN/m}^2$ . 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]
- |                         |                      |                      |
|-------------------------|----------------------|----------------------|
| $\sigma_3$              | $99 \text{ kN/m}^2$  | $201 \text{ kN/m}^2$ |
| $(\sigma_1 - \sigma_3)$ | $155 \text{ kN/m}^2$ | $197 \text{ kN/m}^2$ |
| $u_f$                   | $58 \text{ kN/m}^2$  | $138 \text{ kN/m}^2$ |

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- 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  $300 \text{ kN/m}^2$ . 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]
- |                         |                      |                      |
|-------------------------|----------------------|----------------------|
| $\sigma_3$              | $100 \text{ kN/m}^2$ | $200 \text{ kN/m}^2$ |
| $(\sigma_1 - \sigma_3)$ | $156 \text{ kN/m}^2$ | $198 \text{ kN/m}^2$ |
| uf                      | $58 \text{ kN/m}^2$  | $138 \text{ kN/m}^2$ |

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## III B. Tech I Semester Supplementary Examinations, June/July-2022

**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**

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**PART – A****(22 Marks)**

1. a) What is the zero air void line? [3M]
- b) Define plasticity index. What is its importance? [4M]
- c) State the different modes of soil water. [4M]
- d) What are the assumptions made by Boussinesq's in deriving the expression for stress in soil due to a point load on the ground surface? [4M]
- e) Briefly explain e-p and e-log p curves. [4M]
- f) What is the critical void ratio? On which factor does it depend? [3M]

**PART – B****(48 Marks)**

2. a) Explain the Effect of compaction on soil properties. [8M]
- b) Describe the formation of soil due to mechanical weathering. [8M]
3. a) What is the use of classification of soils? Discuss Indian standard classification system? [8M]
- b) What are the different soil indices used in identification of soil? Describe each one. Give their uses. [8M]
4. a) A soil strata consists of 3 layers of thickness 1m, 1.5m and 2.0 m having the coefficient of permeability of  $2 \times 10^{-3}$  cm/s,  $1.5 \times 10^{-3}$  cm/s and  $3 \times 10^{-3}$  cm/s respectively. Estimate the average coefficient of permeability in the direction:  
(i) parallel to the bedding plane.  
(ii) normal to the bedding plane. [8M]
- b) Derive an expression to determine coefficient of permeability of soil by laboratory falling head permeability test. [8M]

5. a) A rectangular area of  $2\text{m} \times 4\text{m}$  carries a uniformly distributed load  $80 \text{ kN/sq.m}$  at ground surface. Find the vertical pressure at  $5 \text{ m}$  below the center and corner of the loaded area. Solve the problem by dividing the rectangle into four equivalent rectangles. [8M]  
b) Explain 2:1 method. [8M]
6. a) Discuss Terzaghi's theory of consolidation by stating the various assumptions and its validity. [8M]  
b) Describe square root time fitting method. [8M]
7. a) Sketch stress strain diagrams for loose sand, dense sand, soft clay and stiff clay and comment. [8M]  
b) When do you use the following shear tests and give reasons: [8M]  
(i) shear box;  
(ii) vane shear test;  
(iii) unconfined compression test.

**III B. Tech I Semester Supplementary Examinations, February-2022**  
**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**

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**PART –A**

**(22 Marks)**

1. a) What is compaction control? Explain? [3M]
- b) Explain about CU and CC. [4M]
- c) What is the use of New mark's influence chart? [4M]
- d) What are the differences between Bossiness's and Westergaard's theories? [4M]
- e) What is degree of consolidation and what is it's relation with the time factor? [4M]
- f) Explain different drainage conditions for shear testing of soils? [3M]

**PART –B**

**(48 Marks)**

2. a) Explain the difference between IS light and heavy compactions? [8M]
- b) A dry soil has a void ratio of 0.65 and its grain specific gravity is  $\gamma_s = 2.80$ . [8M]
  - (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? Explain Total, neutral and effective stresses? [8M]
- b) The laboratory tests on a sample of soil gave the following results: [8M]  
wn - 24%, w<sub>L</sub> = 62%, wp = 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? [8M]  
b) In order to compute the seepage loss through the foundation of a cofferdam, flow nets 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 meter length of dam per day? [8M]
5. a) Explain how the New mark's influence chart is prepared and used. [8M]  
b) 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<sup>2</sup>. 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. [8M]
6. a) What are the assumptions in Terzaghi's 1-D Consolidation theory? [8M]  
b) Explain consolidation concept?  
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). [8M]

7. a) How do soils attain their shear strength? Explain soil strength envelope? [8M]
- b) Given the following data from a consolidated un-drained test [8M]  
with pore water pressure measurement, determine the total and effective stress parameters:

$\sigma_3$	99 kN/m <sup>2</sup>	201 kN/m <sup>2</sup>
$(\sigma_1 - \sigma_3)$	155 kN/m <sup>2</sup>	197 kN/m <sup>2</sup>
uf	58 kN/m <sup>2</sup>	138 kN/m <sup>2</sup>

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## III B. Tech I Semester Supplementary Examinations, March – 2021

## 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 compulsory3. Answer any **THREE** Questions from **Part-B**

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**PART –A****(22 Marks)**

1. a) Sketch the phase diagram for a soil. [3M]
- b) Name different types of soil classifications. [4M]
- c) What is the role of effective stress in soil mechanics? [4M]
- d) What is Pressure bulb? [4M]
- e) State the assumptions made in Terzaghi's theory of one-dimensional consolidation. [4M]
- f) Explain the basic differences between a box shear test and a triaxial shear test for soils. [3M]

**PART –B****(48 Marks)**

2. a) What is compaction? Explain the Method of compaction in detail. [8M]
- b) Write detailed notes on any two clay minerals. [8M]
3. a) Describe the field identification tests to distinguish between clay and silt. What are common classification tests? [8M]
- b) Explain in detail the Indian System of soil classification. When would you use dual symbols for soils? [8M]
4. a) What is the principle of a flow net? What are its uses? What are the salient characteristics of a flow net? [8M]
- b) A falling head permeability test is to be performed on a soil sample whose permeability is estimated to be about  $3 \times 10^{-5}$  cm/s. What diameter of the standpipe should be used if the head is to drop from 27.5 cm to 20.0 cm in 5 minutes and if the cross-sectional area and length of the sample are respectively  $15 \text{ cm}^2$  and 8.5 cm? Will it take the same time for the head to drop from 37.7 cm to 30.0 cm? [8M]
5. a) Write a short note on Newmark's influence chart. [8M]
- b) A ring foundation is of 3 m external diameter and 2 m internal diameter. It transmits a uniform pressure of  $90 \text{ kN/m}^2$ . Calculate the vertical stress at a depth of 1.5 m directly beneath the centre of the loaded area. [8M]



6. a) Define the terms 'Compression index', coefficient of consolidation', and 'coefficient of compressibility', and indicate their units and symbols. [8M]  
b) A 30 mm thick oedometer sample of clay reached 30% consolidation in 15 minutes with drainage at top and bottom. How long would it take the clay layer from which this sample was obtained to reach 60% consolidation? The clay layer had one-way drainage and was 6 m thick. [8M]
7. a) Explain Coulomb's law for shearing strength of soils. [8M]  
b) A triaxial compression test on a cohesive soil sample of cylindrical shape yielded the following results: [8M]  
Major principal stress ... 100 kN/m<sup>2</sup>  
Minor principal stress ... 250 kN/m<sup>2</sup>  
If the angle of inclination of the rupture plane to the horizontal is 60°, determine the cohesion and angle of internal friction by drawing Mohr circle or by calculation.

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## III B. Tech I Semester Supplementary Examinations, October/November - 2020

## 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 compulsory3. Answer any **THREE** Questions from **Part-B****PART – A****(22 Marks)**

1. a) Sketch the phase diagram for a soil and indicate the volumes and weights of the phases on it. Define 'Void ratio', 'Degree of saturation', and 'Water content'. What is a unit phase diagram? [3M]
- b) Draw a typical grain size distribution curves for different types of soils. [4M]
- c) Define "Critical hydraulic gradient" and derive equation for it. [4M]
- d) What do you understand by 'Pressure bulb'? Illustrate with sketches. [4M]
- e) State the assumptions made in Terzaghi's theory of one-dimensional consolidation. [4M]
- f) Differentiate between shear strength parameters obtained from total and effective stress considerations. [3M]

**PART – B****(48 Marks)**

2. a) Explain: i) Field compaction control ii) Method of compaction. [8M]
- b) Write a detailed note on montmorillonite. [8M]
3. a) Define and explain: Liquid limit; Plastic limit; shrinkage limit; and Plasticity index. Briefly describe the procedure to determine the Liquid Limit of a soil. [8M]
- b) Describe in detail the Indian System of soil classification. When would you use dual symbols for soils? [8M]
4. a) Describe clearly with a neat sketch how you will determine the coefficient of permeability of a clay sample in the laboratory and derive the expression used to compute the permeability coefficient. Mention the various precautions, you suggest, to improve the reliability of the test results. [8M]
- b) A uniform homogeneous sand deposit of specific gravity 2.60 and void ratio 0.65 extends to a large depth. The ground water table is 2 m from G.L. Determine the effective, neutral, and total stress at depths of 2 m and 6 m. Assume that the soil from 1 m to 2 m has capillary moisture leading to degree of saturation of 60%. [8M]
5. a) Write a brief critical note on 'Newmark's influence chart'. [8M]
- b) A reinforced concrete water tank of size 6 m × 6 m and resting on ground surface carries a uniformly distributed load of 200 kN/m<sup>2</sup>. Estimate the maximum vertical pressure at a depth of 12 metres vertically below the centre of the base. [8M]

6. a) Define 'preconsolidation pressure'. In what ways is its determination important in soil engineering practice? Describe a suitable procedure for determining the preconsolidation pressure. [8M]
- b) A stratum of clay 5 m thick is sandwiched between highly permeable sand strata. A sample of this clay, 25 mm thick, experienced 50% of ultimate settlement in 12 minutes after the application of a certain pressure. How long will it take for a building proposed to be constructed at this site, and which is expected to increase the pressure to a value comparable to that applied in the laboratory test, to settle 50% of the ultimate value? [8M]
7. a) Explain the Mohr-Coulomb strength envelope. What is the effect of pore pressure in strength of soils? [8M]
- b) Samples of compacted, clean, dry sand were tested in a shear box, 6 cm × 6 cm, and the following: [8M]  
observations were recorded:  
Normal load (N): 100 200 300  
Peak shear load (N): 90 180 270  
Ultimate shear load (N): 75 150 225  
Determine the angle of shearing resistance in (i) the dense state and in (ii) the loose state.

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## III B.Tech I Semester Supplementary Examinations, October/November - 2019

**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****(22 Marks)**

- 1 a) Write short note on Adsorbed Water. [3M]  
 b) Define the term Relative Density. [4M]  
 c) Write short note on uses of flow nets in the seepage analysis. [4M]  
 d) What are the factors that affect compaction? [3M]  
 e) When we call soil is over consolidated? Explain with the aid of Stress versus deformation diagram. [4M]  
 f) What is the drainage conditions generally used in tri-axial compression test? [4M]

**PART –B****(48 Marks)**

- 2 a) Derive the relation between bulk unit weight of the soil, specific gravity of soil solids, void ratio, water content, and unit weight of the water. [8M]  
 b) The following results were obtained from a standard compaction test on a soil: [8M]

|                   |      |      |      |      |      |
|-------------------|------|------|------|------|------|
| Mass (g)          | 2010 | 2092 | 2114 | 2100 | 2055 |
| Water Content (%) | 12.8 | 14.5 | 15.6 | 16.8 | 19.2 |

The value of  $G_s$  is 2.67. Plot the dry density – water content curve and give the optimum water content and maximum dry density? Plot also the curves of 100 %, 95 % and 90 % saturation curves. The volume of the mould is  $1000 \text{ cm}^3$ .

- 3 a) Liquid limit test on a given sample gave the following values: [8M]

|                   |      |      |      |      |
|-------------------|------|------|------|------|
| Water Content (%) | 47.5 | 49.5 | 51.9 | 53.9 |
| Number of Blows   | 38   | 27   | 20   | 43   |

Plot the values on semi log-sheet and determine the liquid limit and flow index.

- b) The following values of sand are given:  $D_{60} = 0.77 \text{ mm}$ ,  $D_{30} = 0.41 \text{ mm}$  and  $D_{10} = 0.30 \text{ mm}$ . Determine,  $C_u$  and  $C_c$  and state if it is a well graded or poorly graded soil? [8M]
- 4 a) Define Quick sand condition and Derive the expression for critical hydraulic gradient. [8M]  
 b) A soil strata consists of 3 layers of thickness 1 m, 1.5 m and 1.9 m having the coefficients of permeability of  $2.3 \times 10^{-3} \text{ cm/s}$ ,  $1.85 \times 10^{-3} \text{ cm/s}$  and  $3.5 \times 10^{-4} \text{ cm/s}$  respectively. Estimate the average coefficient of permeability in the direction:  
 i) parallel and ii) normal to the flow. [8M]

- 5 a) Two concentrated loads of 500 kN and 900 kN are situated 5 m apart on the ground surface. Find out the vertical stresses at 3.0 m below each load. [8M]
- b) A Newmark's chart was prepared with the influence coefficient of 0.005 with the desired scale the stress concentrated area is drawn on tracing paper. Then the tracing paper is placed on top of the influence chart with the desired position. Then number of sectors covered by the stress area is 31. Compute the stress at the given position for the desired stress area. Applied on the area is  $200 \text{ kN/m}^2$ . [8M]
- 6 a) Explain any one method to compute coefficient of consolidation. [8M]
- b) There is a layer of soft clay 4 m thick under a newly constructed building. The overburden pressure over the center of the clay layer is  $300 \text{ kN/m}^2$ . Compute the settlement, if there is an increase in pressure due to construction of  $100 \text{ kN/m}^2$ . Take  $C_c = 0.50$ ,  $G = 2.70$ . The water content of the deposit was found to be 50 %. [8M]
- 7 a) Sketch the stress –strain relationship for dense sand and loose sand. [8M]
- b) The flowing test results are obtained from the direct shear test. Compute the shear strength parameters. Dimensions of the sample are 6 cm X 6 cm X 2 cm. [8M]

|                                    |      |     |       |       |       |
|------------------------------------|------|-----|-------|-------|-------|
| Normal stress ( $\text{kg/cm}^2$ ) | 0.3  | 0.4 | 0.5   | 0.6   | 0.7   |
| Shear Load (kg.)                   | 6.75 | 9.0 | 11.25 | 13.50 | 15.75 |

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