U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: IV**

Branch: Civil Engineering **Duration: 3 hrs.**

Course Code: 19CV4PCGTE **Max Marks: 100**

Course: Geotechnical Engineering-I

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	*CO*	*PO*	Marks
1	a)	Define the following with the help of a phase diagram a) Void ratio b) Porosity c) Air content d) Percentage air void e) Degree of saturation	*CO1*	*PO1*	**10**
	b)	An embankment is to be constructed with a void ratio of 0.85 and quantity of embankment being 5000m^3. Three borrow pits are available for the construction of the embankment and the corresponding void ratio and the cost of transportation for 1m^3 of soil given below. Determine the most economical borrow pit. Borrow pit | Void ratio | Cost/m^3 in Rs. A | 0.95 | 30 B | 1.90 | 16 C | 1.65 | 25	*CO2*	*PO2*	**10**
		OR			
2	a)	With the help of a phase diagram, define the terms bulk density, dry density and saturated density. Also plot the phase diagrams for dry soil and saturated soil.	*CO1*	*PO1*	**10**
	b)	In its natural condition, a soil sample has a mass of 2280g and a volume of 1.14 x $10^{-3}m^3$. After being completely dried in an oven, the mass of the sample is 2029g. The value of G for the soil is 2.67. Determine the bulk density, bulk unit weight, water content, void ratio, porosity, degree of saturation and air content.	*CO2*	*PO2*	**10**

			UNIT - II			
	3	a)	List and discuss the tests involved in field identification of soils	*CO1*	*PO1*	**08**
		b)	The in -situ porosity of a sand deposit is 34%. For determining the density index, dried sand from the stratum was first loosely filled in 1000cm^3 mould and was then vibrated to give a maximum density. The loose dry mass in the mould was 1610g and dense dry mass at maximum density was found to be 1980g. Determine the density index of the sand, if G=2.67	*CO2*	*PO2*	**12**
			OR			
	4	a)	Explain IS soil classification system for both Coarse-Grained and Fine-Grained soils by sketching the Plasticity Chart	*CO1*	*PO1*	**08**
		b)	The following data were obtained from a liquid limit test No. of blows: 28, 26, 17, 13 Water content (%): 105.1, 105.7, 110.9, 112.2 Two plastic limit determinations gave water content of 34.5% and 35.2%. Plot the flow curve. Determine liquid limit, plasticity index, flow index, toughness index. Assuming G=2.80, calculate the void ratio of the saturated soil at liquid limit and plastic limit.	*CO2*	*PO2*	**12**
			UNIT - III			
	5	a)	Discuss the types of soil structure.	*CO1*	*PO1*	**06**
		b)	Explain with neat sketch, Kaolinite clay mineral	*CO1*	*PO1*	**06**
		c)	Compute the total, effective and pore pressure at a depth of 15m below the bottom of a lake 6m deep. The bottom of the lake consists of soft clay with a thickness of more than 15m. The average water content of the clay is 40% and the specific gravity of soil may be assumed to be 2.65.	*CO2*	*PO2*	**08**
			OR			
	6	a)	Discuss any two major clay minerals with neat sketches	*CO1*	*PO1*	**06**
		b)	Briefly explain i. Cation exchange capacity ii. Capillary rise in soils iii. Flocculated structure	*CO1*	*PO1*	**06**
		c)	Determine the neutral and effective stress at a depth of 16m below the ground level for the following conditions: Water table is 3m below ground level, Gs=2.68, e=0.72, average water content of the soil above water table is 8%.	*CO2*	*PO2*	**08**

<table>
<tr><td></td><td></td><td></td><td>UNIT - IV</td><td></td><td></td><td></td></tr>
<tr><td></td><td>7</td><td>a)</td><td>Discuss the factors affecting permeability of soils.</td><td>CO1</td><td>PO1</td><td>10</td></tr>
<tr><td></td><td></td><td>b)</td><td>A stratified soil consists approximately of alternating layers of sand and silt. The sand layers are generally 150mm in thickness and have a permeability of k=2.5 x 10^{-1} mm/s, the silt layers are 1.80m thick and have a k=2.5 x 10^{-4}mm/s. Assuming that within each layer flow condition is isotropic, determine the ratio of horizontal permeability to that of the vertical.</td><td>CO2</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>8</td><td>a)</td><td>Discuss the factors affecting compaction in soils</td><td>CO1</td><td>PO1</td><td>10</td></tr>
<tr><td></td><td></td><td>b)</td><td>The observations of a standard proctor test are given below
<table><tr><td>Water content (%)</td><td>12.85</td><td>14.28</td><td>15.65</td><td>16.86</td><td>17.89</td></tr><tr><td>Bulk density (g/cc)</td><td>2.06</td><td>2.10</td><td>2.15</td><td>2.16</td><td>2.14</td></tr></table>Plot the compaction curve and determine the OMC and MDD. Also plot the ZAV line (Take G=2.72)</td><td>CO2</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td></td><td></td><td>UNIT - V</td><td></td><td></td><td></td></tr>
<tr><td></td><td>9</td><td>a)</td><td>Discuss the factors affecting shear strength of cohesionless soils</td><td>CO1</td><td>PO1</td><td>05</td></tr>
<tr><td></td><td></td><td>b)</td><td>Explain the advantages and disadvantages of unconfined compression test</td><td>CO1</td><td>PO1</td><td>05</td></tr>
<tr><td></td><td></td><td>c)</td><td>A drained triaxial compression test carried out on three specimens of the same soil yielded the following results.
<table><tr><td>Test No.</td><td>1</td><td>2</td><td>3</td></tr><tr><td>Cell pressure (kPa)</td><td>100</td><td>200</td><td>300</td></tr><tr><td>Ultimate deviator stress (kPa)</td><td>210</td><td>438</td><td>644</td></tr></table>Draw the strength envelope and determine the shear strength parameters.</td><td>CO2</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>10</td><td>a)</td><td>Discuss the possible drainage conditions under which shear tests are conducted.</td><td>CO1</td><td>PO1</td><td>05</td></tr>
<tr><td></td><td></td><td>b)</td><td>List the advantages of triaxial shear test over direct shear test</td><td>CO1</td><td>PO1</td><td>05</td></tr>
<tr><td></td><td></td><td>c)</td><td>Two identical soil specimens were tested in a triaxial apparatus. First specimen failed at a deviator stress of 770kPa, when call pressure was 200kPa. Second specimen failed at a deviator stress of 1370kPa, when the cell pressure was 400kPa. Determine the value of c and phi analytically. If the same soil is tested in a direct shear apparatus with a normal stress of 600kPa, estimate the shear stress at failure.</td><td>CO2</td><td>PO2</td><td>10</td></tr>
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