SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF AGRICULTURE ENGINEERING

QUESTION BANK

III SEMESTER

1902301–SOIL SCIENCE AND ENGINEERING

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Prepared by

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SUBJECT CODE/NAME: 1902301–SOIL SCIENCE AND ENGINEERING
SEM/YEAR: III/II

UNIT I – INTRODUCTION AND SOIL PHYSICS

Soil - definition - major components – Soil forming minerals and processes - soil profile-Physical properties - texture – density – porosity – consistence – colour - specific gravity- capillary and non - capillary – plasticity - Soil air - soil temperature - soil water -classification of soil water - Movement soil water - Soil colloids – organic and inorganic matter - Ion exchange- pH – Plant nutrient availability.

PART A

Q.NO	QUESTIONS	BT LEVEL	COMPETENCE
1.	Define major components of soil	BT-1	Remember
2.	What are the physical properties of soil?	BT-1	Remember
3.	Why texture of soil important?	BT-1	Remember
4.	Define air content and percentage air content in soil.	BT-1	Remember
5.	Define porosity.	BT-1	Remember
6.	Define specific gravity of soil and list methods to determine it.	BT-1	Remember
7.	What are the properties of montmornilite mineral?	BT-2	Understand
8.	Discuss about water content of a soil mass	BT-2	Understand
9.	Differentiate between plasticity and consistency.	BT-2	Understand
10.	Discuss the types of soil moisture and its importance in plant growth	BT-2	Understand
11.	Identify the minerals which are present in soil.	BT-3	Apply
12.	List major mineral present in clay and sand. And what mineral in present in red soil.	BT-3	Apply
13.	Derive the relationship between void ratio and porosity.	BT-3	Apply
14.	Why Ion exchange property of soil is identified	BT-4	Analyse
15.	List methods to improve the quality of soil	BT-4	Analyse
16.	List methods to identify permeability of soil	BT-4	Analyse

17.	What is water holding capacity of soil?	BT-5	Evaluate
18.	Which mineral in clay causes volume change behavior, how is it controlled?	BT-5	Evaluate
19.	Sketch the influence of temperature of soil property and its behavior.	BT-6	Create
20.	Define soil collides.	BT-6	Create
21.	List methods of determining soil pH.	BT-1	Remember
22.	Differentiate porosity and void ratio	BT-4	Analyse
23.	Define Liquid Limit	BT-2	Understand
24.	Differentiate saturated density and submerged density.	BT-4	Analyse
25.	Define plant nutrients.	BT-2	Understand
PART B			
1.	Explain various soil moisture and effect of capillarity.	BT – 1	Remember
2.	Discuss the physical properties of soil in detail.	BT – 1	Remember
3.	Brief the methods of soil profiling and soil logging.	BT – 1	Remember
4.	Explain how a seismic testing of soil profile is done.	BT – 2	Understand
5.	Explain how a Electrical resistivity testing of soil profile is done.	BT – 2	Understand
6.	List various minerals present in soil and its uses.	BT -3	Apply
7.	Explain field and laboratory method of determination of density	BT- 4	Analyse
8.	Derive the equation to derive specific gravity using pyconometer method. What are the other methods to determine specific gravity.	BT – 4	Analyse
9.	Explain field and laboratory method of determination of permeability.	BT- 5	Evaluate
10.	Brief the procedure listed in IS code for determination of ion exchange property of soil.	BT – 5	Evaluate
11.	List the clay minerals and its uses. Brief the chemical composition of the clay minerals its arrangement and its effect on reaction with water.	BT – 5	Evaluate
12.	Brief the importance of organic and inorganic materials present in soil how will it affect the plant growth.	BT – 6	Create
13.	List the procedure to test the plant nutrient availability.	BT – 6	Create
14.	How the direction movement of water affect permeability. Derive the respective equations.	BT – 6	Create
PART C			
1.	Brief the chemical composition of the soil minerals its arrangement and its effect on reaction with water.	BT – 2	Understand
2.	Explain laboratory method of determination of permeability.	BT -3	Apply
3.	List and explain non destructive methods of identifying soil profile.	BT- 4	Analyse
4.	Brief methods of determining the ion exchange property of soil.	BT – 6	Create

UNIT II – SOIL CLASSIFICATION AND SURVEY

Soil taxonomy – Soils of Tamil Nadu and India. Soil survey - types and methods of soil survey – Field mapping- mapping units - base maps -preparation of survey reports - concepts and uses - land capability classes and subclasses - soil suitability – Problem soils – Reclamation.

PART A

Q.NO	QUESTIONS	BT LEVEL	COMPETENCE
1.	Define A-line and its uses.	BT-1	Remember
2.	What are uses of survey report?	BT-1	Remember
3.	Why swell potential of soil an important character?	BT-1	Remember
4.	Define problem due to soil salinity.	BT-1	Remember
5.	Define base map.	BT-1	Remember
6.	Which mineral makes the soil problematic?	BT-1	Remember
7.	Define mapping units.	BT-2	Understand
8.	Discuss about soil suitability.	BT-2	Understand
9.	Differentiate soil suitability and land capability.	BT-2	Understand
10.	Discuss the problem soils and give example.	BT-2	Understand
11.	Identify the land capability subclasses.	BT-3	Apply
12.	List major characteristics of field mapping.	BT-3	Apply
13.	Derive the suitable method of classification for agricultural purpose.	BT-3	Apply
14.	Why preparation of survey reports important?	BT-4	Analyse
15.	List major types of soil in Tamil Nadu.	BT-4	Analyse
16.	List the land capability classes.	BT-4	Analyse
17.	What are major type of soil present in India?	BT-5	Evaluate
18.	Which mineral in clay causes volume change behavior, how is it controlled?	BT-5	Evaluate
19.	Sketch the methods of soil reclamation.	BT-6	Create
20.	Define the basis of soil taxonomy.	BT-6	Create
21.	List methods of determining land capability.	BT-1	Remember
22.	Differentiate geological map and forest inventory map.	BT-4	Analyse
23.	Define vegetation and land use map.	BT-2	Understand
24.	Differentiate aerial photography and remote sensing.	BT-4	Analyse
25.	Define preparation of mapping legend.	BT-2	Understand

PART B

1.	Explain field mapping and its characteristics.	BT – 1	Remember
2.	Discuss the preparation of base and survey report.	BT – 1	Remember

3.	Brief the uses of aerial photography in soil survey.	BT – 1	Remember
4.	Explain geological map, vegetation and land uses map, forest inventory map.	BT – 2	Understand
5.	Explain how a survey report helps in identifying plant nutrient.	BT – 2	Understand
6.	List various condition of soil suitability.	BT -3	Apply
7.	Explain hydrometer analysis for identifying grain size of soil.	BT- 4	Analyse
8.	Derive on what basis the survey land capability classes and classes are done.	BT – 4	Analyse
9.	Explain problems faced in clay soil and list the remedial measures.	BT- 5	Evaluate
10.	Brief the procedure for identifying land capability.	BT – 5	Evaluate
11.	Brief IS soil classification for clay soil.	BT – 5	Evaluate
12.	Brief the properties of soil present in Tamil Nadu and India.	BT – 6	Create
13.	List the methods of soil survey and brief its procedure.	BT – 6	Create
14.	List the problematic soil and the remedial process for it.	BT – 6	Create
PART C			
1.	Explain IS method of soil classification	BT – 2	Understand
2.	Brief the method of classification of soil which is helpful for agricultural purpose.	BT -3	Apply
3.	Brief the preparation of base map and survey report.	BT- 4	Analyse
4.	List the land capability, classes and subclasses.	BT – 6	Create

UNIT III - PHASE RELATIONSHIP AND SOIL COMPACTION

Phase relations- Gradation analysis- Atterberg Limits and Indices- Engineering Classification of soil – Soil compaction- factors affecting compaction- field and laboratory methods.

PART A

Q.NO	QUESTIONS	BT LEVEL	COMPETENCE
1.	Define degree of saturation and shrinkage ratio.	BT-1	Remember
2.	What are the Atterberg‟s limits? List its types.	BT-1	Remember
3.	If the volume of voids is equal to the volume of solids in a given soil sample, Find void ratio and porosity.	BT-1	Remember
4.	Define Submerged unit weight of soil.	BT-1	Remember
5.	Define compaction.	BT-1	Remember
6.	Define Optimum Moisture content.	BT-1	Remember
7.	Define plasticity index and flow index.	BT-2	Understand
8.	Discuss about Shrinkage limit and its effect on volume change.	BT-2	Understand
9.	Differentiate between plasticity and consistency.	BT-2	Understand

10.	The natural water content of an excavated soil from the borrow pit is 35%. Its liquid limit is 65% and plasticity limit is 25%. Determine the Liquidity Index of the soil and comment about the consistency of the soil.	BT-2	Understand
11.	A compacted sample of soil with a bulk unit weight of 19.62kN/m^3 has a water content of 15 percent. Calculate its dry density, degree of saturation and air content? Assume G = 2.65.	BT-3	Apply
12.	What is a zero air voids line?Draw a compaction curve and show the zero air voids line.	BT-3	Apply
13.	Derive the relationship between void ratio and porosity.	BT-3	Apply
14.	State whether the following statement is true or false and justify your answer. The efficiency of compaction improves with increase in compactive effort.	BT-4	Analyse
15.	List any four equipment/ methods for field compaction of Soil.	BT-4	Analyse
16.	List various field compaction equipments along with its suitability. **Soil properties** / **Clay A** / **Clay B** **Liquid limit** 44% 55% **Plastic limit** 29% 35% **Natural water content** 30% 50%	BT-4	Analyse
17.	Compose a relation for γ_{sat} with G, γ_w and e.	BT-5	Evaluate
18.	A dry clay has a mass of 30g and volume of 15cc, What will be the shrinkage limit if the specific gravity of solids is 2.65	BT-5	Evaluate
19.	Draw the phase diagram for completely dry and fully saturated soil mass.	BT-6	Create
20.	Two clay samples A and B have the following properties: Which of the clays A or B would experience larger settlement under identical loads? Conclude with your comments by classifying the soils.	BT-6	Create
21.	List various factors affecting compaction.	BT-1	Remember
22.	Differentiate porosity and void ratio	BT-4	Analyse
23.	Define Liquid Limit	BT-2	Understand
24.	Difference between modified and standard compaction test.	BT-3	Apply
25.	Dry unit weight of soil is 13.75KN/m^3 and water content is 17%.Determine the bulk unit weight.	BT-5	Evaluate
	PART B		
1.	Explain Indian Standard soil classification system	BT – 1	Remember

2.	(i) By three phase soil system, show that the degree of saturation S (as ratio) in terms of mass unit weight(γ), void ratio (e),specific gravity of soil grains(G) and unit weight of water (γ_w) is given by theexpression: $$\gamma = \frac{(G + eS)\gamma_w}{1 + e}$$ (6) (ii) A compacted cylindrical specimen 50 mm diameter and 100 mm long is to be prepared from dry soil. If the specimen is required to have a water content of 15% and the percentage of air voids is 20, calculate the weight of soil and water required in the preparation of soil where specific gravity=2.69. (7)	BT – 1	Remember
3.	In an earth dam under construction, the bulk unit weight is 16.5 kN/m^3 at water content 11%. If the water content has to be increased to 15%, compute the quantity of water to be added per cu.m of soil. Assume no change in void ratio. Determine the degree of saturation at this water content. Take G = 2.7.	BT – 1	Remember
4.	(i) A partially saturated soil from an earth fill has a natural water content of 22% and a bulk unit weight of 19 kN/m^3. Assuming the specific gravity of soil solids as 2.65, compute the degree of saturation and void ratio. If subsequently the soil gets saturated, determine the dry density, buoyant unit weight and saturated unit weight. (8) (ii) Explain Indian Standard soil classification system for classifying coarsegrainedsoil. (5)	BT – 2	Understand
5.	Discuss about the grain size distribution of soil by i) Sieveanalysis. ii) Sedimentationanalysis	BT – 2	Understand
6.	Sandy soil in a borrow pit has unit weight of solids as 25.8kN/m^3, water content equal to11% and bulk unit weight equal to 16.4kN/m^3. How many cubic meter of compacted fill could be constructed of 3500m^3 of sand excavated from the borrow pit, if the required value of porosity in the compacted fill is 30%. Also calculate the change in degree of saturation.	BT -3	Apply
7.	Explain the IS soil classification system for soil.	BT- 4	Analyse
8.	(i) Discuss the effect of compaction on various engineering propertiesofsoils. (5) (ii) A soil sample is found to have the following properties. Classify the soil according to IS classification system. Passing 75μ sieve = 10%; passing 4.75 mm sieve = 70%; Uniformity coefficient =8; coefficient of curvature = 2.8; Plasticity index = 4%. (8)	BT – 4	Analyse
9.	A laboratory compaction test on soil having G= 2.67 gave a maximumdryunitweightof17.8KN/m3andawatercontentof	BT- 5	Evaluate

<table>
<tr><td></td><td>15%. Determine the degree of saturation, air content and percentage air voids at the maximum dry unit weight. What would be theoretical maximum dry unit weight corresponding to zero air voids at the optimum water content?</td><td></td><td></td></tr>
<tr><td>10.</td><td>(i) A cubic meter of soil in its natural state weighs 17.75 kN, after beingdrieditweighs15.08kN.Thespecificgravityofthesoilis 2.70. Determine the degree of saturation, void ratio, porosity and water content of the originalsoilsample. (7)
(ii) Discuss the effect of compaction on various engineering propertiesofsoils. (6)</td><td>BT- 6</td><td>Create</td></tr>
<tr><td>11.</td><td>In its natural condition, a soil sample has a mass of 22.9 N and a volume of 1.15 x 10^{-3} m^3. After being completely dried in the oven sample weighs 20.35 N. Find bulk density, water content, void ratio, porosity, degree of saturation, air content, drydensity and percentage air voids.</td><td>BT – 1</td><td>Remember</td></tr>
<tr><td>12.</td><td>(i) Derive the relationship between porosity and void ratio.(5)
(ii) A partially saturated sample from a borrow pit has a natural moisture content of 15% and bulk unit weight of 1.9 g/cc. G = 2.7. Determine the degree of saturation and void ratio. What will be the unit weight of the soil if itgets saturated. (8)</td><td>BT – 2</td><td>Understand</td></tr>
<tr><td>13.</td><td>(i) Describe the proctor compaction testin detail. (7)
(ii) Draw the diagram for the three Atterberg Limits of a soil and mark the varioussoilphases. (3)
(iii) Define Sensitivity and Thixotropy forasoil. (3)</td><td>BT – 3</td><td>Apply</td></tr>
<tr><td>14.</td><td>(i) A partially saturated soil samples collected from a pit has a natural moisture content of 18% and bulk unit weight of 20 kN/m^3. G = 2.68. Estimate the void ratio and degree of saturation. What will be the unit weight of the soil sample on saturation?(8)
(ii) Discuss the engineering behaviour of compacted cohesive soils. (7)</td><td>BT – 4</td><td>Analyse</td></tr>
<tr><td colspan="4">PART-C</td></tr>
<tr><td>1.</td><td>A soil mass in its natural state is partially saturated having a water content of 17.5 percent and void ratio of 0.87. Determine the degree of saturation, total unit weight, dry unit weight what is the weight of water required to make a mass of 10 m^3 volume to get saturated assume G = 2.69.</td><td>BT-1</td><td>Remember</td></tr>
<tr><td>2.</td><td>500 gms of dry soil was used for sieve analysis the masses of soil retained on each sieve is given below:
<table>
<tr><td>I.S. sieve</td><td>2mm</td><td>1.4mm</td><td>1mm</td><td>500µ</td><td>250µ</td><td>125µ</td><td>75µ</td></tr>
<tr><td>Mass in gms</td><td>10</td><td>18</td><td>60</td><td>135</td><td>145</td><td>56</td><td>45</td></tr>
</table>
Plot the grain size distribution curve and compute the following:
a) Percentage of gravel, coarse sand, medium sand, fine sand and silt as per I.S 1498</td><td>BT – 3</td><td>Apply</td></tr>
</table>

	b) Uniformitycoefficient c) Coefficient of curvature, classify thesoil.		
3.	Test on a soil sample from a borrow area resulted specific gravity of 2.7, void ration = 0.65 and water content of 15%. What is the quantity of soil required to construct an embankment volume of 8000 m3, if the borrow materials compacted to achieve maximum dry density of 18 kN/m3 at a moisture content 18%. Calculate addition quantity of water required for every cubic meter of compacted soil.	BT-2	Understand
4.	A sample of clay was coated with paraffin wax and its mas, including the mass of wax, was found to be 697.5 g. The sample was immersed in water and the volume of the water displaced was found to be 355 ml. The mass of the sample without wax was 690 g, and the water content of the representative specimen was 18%. Determine the bulk density, dry density, void ratio and the degree of saturation. The specific gravity of the solids was 2.7 and that of the wax was 0.89.	BT-2	Understand

UNIT IV - ENGINEERING PROPERTIES OF SOIL

Shear strength of cohesive and cohesionless - Mohr-Coulomb failure theory- Measurement of shear strength, direct shear, Triaxial and vane shear test - Permeability- Coefficient of Permeability-Darcy's law-field and lab methods - Assessment of seepage – Compressibility – Liquefaction.

PART A

Q.NO	QUESTIONS	BT LEVEL	COMPETENCE
1.	Define Cohesion.	BT-1	Remember
2.	What do you meant by Thixotropy?	BT-1	Remember
3.	What is the effect of pore pressure on shear strength of soil?	BT-1	Remember
4.	What is angle of internal friction?	BT-1	Remember
5.	Why triaxial shear test is considered better than direct shear test?	BT-1	Remember
6.	When is vane shear test adopted? Write the expressions to determine the shear strength of soil.	BT-1	Remember
7.	Show the coulomb"s expression for shear strength.	BT-2	Understand
8.	Show the diagram of strength envelopes for fully saturated clay subjected to CD test and fully saturated sand subjected to UU test.	BT-2	Understand
9.	Classify the types of shear test based on drainage conditions?	BT-2	Understand
10.	Define permeability.	BT-2	Understand

11.	What are the factors affecting permeability?	BT-3	Application
12.	State Darcy‟s law	BT-3	Application
13.	Write down the Mohr‟s-Coulomb failure criterion for soils and explain the terms involved.	BT-3	Application
14.	List out the advantages of direct shear test.	BT-4	Analyze
15.	Examine and give one example each of the use of CU strength and CD strength results in engineering practice.	BT-4	Analyze
16.	Examine and conclude whether the following statement is true or false. On the failure plane, the shear stress is maximum.	BT-4	Analyze
17.	Explain the merits of triaxial test.	BT-5	Evaluate
18.	List out the methods of drawing flow net.	BT-5	Evaluate
19.	Draw the Mohr's Circle diagram for UCC test and mention the salient features.	BT-6	Create
20.	Draw the typical stress-strain curve for specimens failed by brittle failure and plastic failure.	BT-6	Create
21.	What is Quick sand condition? List the conditions for the occurrence of quick sand condition.	BT-1	Remember
22.	Discuss the disadvantages of direct shear test.	BT-4	Analyze
23.	Draw the strength envelope for a fully saturated clay for CD and UU test	BT-6	Create
24.	List out the shear stress parameters	BT-4	Analyze
25.	Explain the demerits of triaxial test.	BT-5	Evaluate
	PART B		
1.	The stress on a failure plane in a drained test on a cohesion-less soil are as under: Normal stress (σ) = 100 kN/m^2 Shear stress (τ) = 40kN/m^2. i. Find the angle of shearing resistance and the angle which the failure plane makes with the major principal plane. (7) ii. Find the major and minorprincipalstresses. (6)	BT-1	Remember
2.	The following table gives data obtained from triaxial compression test conducted under undrained condition on two specimens of same soil sample. The diameter and height are 40 mm and 80 mm respectively for both samples.	BT-1	Remember

Specimen no	1	2
Cell Pressure(kN/m^3)	100	200

	Deviator load at failure (N)	637	881		
	Increase in volume at failure(ml)	1.1	1.5		
	Axial compression(mm)	5	7		
	Find C_u and ϕ_u by graphical method.				
3.	The results of a direct shear test on a 60mm x 60mm specimen are given below. Find the shear strength parameters.			BT-1	Remember
	Normal load, N	300	400	500	600
	Shear force at failure,N	195	263	324	399
4.	i. The results of three consolidated undrained triaxial tests on identical specimens of a particular soil are as follows :(7)			BT-1	Remember
	TestNo.	1	2	3	
	Confining stress, kPa	200	300	400	
	Deviatoric stress at peak,kPa	244	314	84	
	Pore water pressure at peak , kPa	55	107	159	
	Find the value of total and effective shear strength parameters.				
	ii. A shear vane of 7.5 cm diameter and 11 cm length was used to measure the shear strength of soft clay. If a torque of 600 N-m was required to shear the soil. Find theshear strength. (6)				
5.	A direct shear test was performed on 60 mm x 60 mm sample of dry sand. The normal load was 360 N. The failure occurred at a shear load of 180 N. Plot the Mohr strength envelope and determine ϕ. Assume c = 0. Also, Identify the principal stressesat			BT-2	Understand

<table>
<tr><td></td><td>failure.</td><td></td><td></td></tr>
<tr><td>6.</td><td>Describe the Vane Shear test in detail and classify the methods adopted in this test-Fully Submerged Vane and Partially Submerged Vane.</td><td>BT-2</td><td>Understand</td></tr>
<tr><td>7.</td><td>A series of three consolidated undrained tests were conducted on an identical clay specimen of 50 mm diameter and height of 120 mm. Deviator load at failure 'p_t', confining pressure 'σ_3' and pore water pressure 'U' recorded are presented below. Identify the total and effective strength parameters both by analytical and Mohr circle method.
<table>
<tr><th>Trial No</th><th>p_t (N)</th><th>σ_s (kN/m^2)</th><th>U (kN/m^2)</th></tr>
<tr><td>1</td><td>100</td><td>510</td><td>-65</td></tr>
<tr><td>2</td><td>200</td><td>720</td><td>-10</td></tr>
<tr><td>3</td><td>40</td><td>11 0</td><td>80</td></tr>
</table></td><td>BT-2</td><td>Understand</td></tr>
<tr><td>8.</td><td>Describe the Unconfined Pumping Out Flow and determine the coefficient of permeability of soil. Also explain Draw Down Curve.</td><td>BT-3</td><td>Application</td></tr>
<tr><td>9.</td><td>In a triaxial test, a soil specimen was consolidated under a cell pressure of 200 kPa and simultaneously a back pressure of 100 kPa is applied to saturate the specimen .Thereafter, with drainage prevented, the cell pressure was raised to 250 kPa resulting in an increased pore pressure of 149kPa. Maintaining the same cell pressure of 250 kPa, now the deviator stress was increased to 170 kPaandporepressureof220kPawasobserved.Identifythepore pressure parameters A and B.</td><td>BT-3</td><td>Application</td></tr>
<tr><td>10.</td><td>Describe in detail with neat sketches, the field determination of permeability</td><td>BT-4</td><td>Analyze</td></tr>
<tr><td>11.</td><td>In a falling head permeability test the length and area of cross section of soil specimen are 0.17 m and 21.8x10^{-4}m^2 respectively. Calculate the time required for the head to drop from 0.25 m to 0.10 m. The area of cross section of stand pipe is 2.0 x 10^{-4} m^2 . The sample has three layers with permeabilities 3 x 10-5 m/sec for first 0.06 m, 4 x 10-^{5} m/sec for second 0.06 m and 6 x 10-^{5} m/sec for the third 0.05 m thickness. Assume the flow is taking place perpendicular to the bedding plane.</td><td>BT-4</td><td>Analyze</td></tr>
</table>

<table>
<tr><td>12.</td><td>i. Direct Shear Test was conducted on Compacted Sand Shear Box Dimensions 60 mm x 60 mm. The readings are listed below.
<table><tr><td>Normal load (N)</td><td>110</td><td>225</td><td>340</td></tr><tr><td>Peak shear load (N)</td><td>95</td><td>195</td><td>294</td></tr><tr><td>Ultimate shear load (N)</td><td>65</td><td>135</td><td>200</td></tr></table>Examine the angle of shearing resistance in
a. Dense compactedstate
b. Loosestate (9)
ii. Define Deviator stress and discover its significance in Triaxial shearstrengthtest. (4)</td><td>BT-4</td><td>Analyze</td></tr>
<tr><td>13.</td><td>i. An earthen embankment is constructed in a soil having cohesion C= 45 kN/m^2 and ϕ'= 26°. Determine the total and effective shear strength of the soil on a horizontal plane at a depth of 10m below the top of an embankment having a bulk unit weight of soil γ_{bulk} =21 kN/m^3 and the pore water pressure at this depth is15 kN/m^2. (8)
ii. Outline the diagram of Mohr-Coulomb failureenvelops CU, CD and UU tests sandy soils and comment on the shearstrengthparameter. (5)</td><td>BT-5</td><td>Evaluate</td></tr>
<tr><td>14.</td><td>i. An unconfined compression test was carried out on a sample of clay had a diameter of 38 mm and a length of 76 mm. The load at failure measured by the proving ring was 45 N and the axial deformation of the sample at failurewas 15 mm. Estimate the unconfined compressive strength, undrained shear strength and undrained cohesion of the claysample. (7)
ii. How do you find the shear strength of soil using Vane Shear test and derive the formula used to calculatethe shear strength. Invent where this test is mostly used?(7)</td><td>BT-6</td><td>Create</td></tr>
<tr><td colspan="4">PART C</td></tr>
<tr><td>1.</td><td>Explain the triaxial shear tests based on drainage and their applicability. Mention its merits and demerits.</td><td>BT-2</td><td>Understand</td></tr>
<tr><td>2.</td><td>i. What is the shear strength in terms of effective stress on a plane within a saturated soil mass at a point where the total normalstressis295kN/m^{2}andtheporewaterpressureis 120 kN/m^2? The effective stress parameters for the soil are</td><td>BT-1</td><td>Remember</td></tr>
</table>

	$c^{\prime\prime}$ = 12 kN/m^2 and$\varphi'=30^0$. (10) ii. List advantages and disadvantages of direct shear test.(5)		
3.	An embankment consists of clay fill for which c'=25 kN/m^2 and $\phi'=27°$ (from consolidated undrained tests with pore-pressure measurement). The average bulk unit weight of the fill is 20 kN/m^3. Estimate the shear-strength of the material on a horizontal plane at a point 20 m below the surface to the embankment, if the pore pressure at this point is 180 kN/m^2 as shown by a piezometer.	BT-5	Evaluate
4.	Explain in detail with neat sketches, the laboratory determination of permeability methods.	BT-3	Application

UNIT 5- BEARING CAPACITY AND SLOPE STABILITY

Bearing capacity of soils - Factors affecting Bearing Capacity- Shallow foundations-Terzaghis formula- BIS standards - Slope stability-Analysis of infinite and finite slopes- friction circle method- slope protection measures.

PART A

Q.NO	QUESTIONS	BT LEVEL	COMPETENCE
1.	Define local shear failure and General shear failure.	BT-1	Remember
2.	Define Co-efficient of volume change and volume change.	BT-1	Remember
3.	What do you understand primary consolidation and secondary consolidation.	BT-1	Remember
4.	Classify the components of settlement	BT-1	Remember
5.	Define Co-efficient of settlement.	BT-1	Remember
6.	Examine the factors consider in seismic design of shallow foundation.	BT-1	Remember
7.	List the requirement of good foundation	BT-2	Understand
8.	Compare Immediate Settlement and consolidation settlement.	BT-4	Analyzing
9.	Sketch the slip circle for a failure plane in a slope and show the forces involved.	BT-2	Understand
10.	Explain critical depth.	BT-2	Understand
11.	Identify when and where the circular failure surface is mobilized.	BT-3	Apply
12.	Write the expression for FOS for friction.	BT-5	Evaluate
13.	Why circular failure surface is mobilized?	BT-3	Apply
14.	Distinguish between finite slope and infinite slope.	BT-4	Analyze
15.	Classify the different modes of failure of finite and infinite slopes.	BT-4	Analyze

16.	List the three forces acting in circular failure while analysing through friction circle method?	BT-4	Analyze
17.	A cuffing is to be made in clay for which the cohesion is 350 kN/m^2; Bulk unit weight is 20 kN/m^3, Determine the maximum depth for a cutting of side slope 1.5 to 1. Factor of safety to be 1.5. Take the stability number as 0.17.	BT-5	Evaluate
18.	Evaluate the maximum depth of soil having undrained cohesion is 50kN/m^2, Unit weight of soil is 19kN/m^3, Stability number is 0.20.	BT-5	Evaluate
19.	Elaborate the effect of depth of failure surface on the stability of infinite slope in Cohesionless soil.	BT-6	Create
20.	Discuss about the three critical conditions for which the stability analysis of an earth dam is carried out.	BT-6	Create
21.	Give the expression for stability number.	BT-3	Apply
22.	Define infinite slope.	BT-1	Remember
23.	Develop points on various slope protection measures.	BT-3	Apply
24.	Write the expression for FOS for cohesion.	BT-5	Evaluate
25.	When will you adopt friction circle method?	BT-6	Create
	PART B		
1.	An R.C. Column footing 2.26 m in square shape is to rest 1.5 m below level ground level is on cohesive soil. The unit weight is 17.6kN/m^3. What is the safe load if cohesion is 30kN/m3 Factor of safety 2.4? Angle of internal friction 33° by IS code.	BT-1	Remembering
2.	How to find the bearing capacity from Standard penetration test and static cone penetration test?	BT-1	Remembering
3.	A square footing located at a depth of 1.5 m below the ground surface in Cohesionless soil carries a column load of 1280 kN. The soil is submerged having an effective unit weight of 11.5 kN/m3 and an angle of shearing resistance of 300. Show and find the size of the footing for Fs = 3 by Terzaghi's theory of general shear failure.	BT-2	Understanding
4.	In a plate bearing test on pure clayey soil failure occurred at a load of 12.2 tonnes. The size of the plate was 45 cm x 45 cm and the test was one at a depth of 1.0 m below ground level. Calculate the ultimate bearing capacity for a 1.5 m wide continuous wall footing with its base at a depth of 2m below ground level. The unit wt. of clay may be taken	BT-2	Understanding

	as 1.9 gm/ c.c.		
5.	A plate load test was conducted with a 30 cm square plate at a depth of 1.2 m below the ground level, in a cohesive soil having Φ = 0. The failure was observed at a load of 36 kN. The water table was observed to be at a depth of 4.7 m below ground surface.Compute the ultimate bearing capacity for a strip footing, 1m wide with its base located at the same level as the test plate, and in the same soil. Take the bulk unit weight of the soil as 16.8 kN/m3 . Also, calculate the safe bearing capacity of factor at a safety of 3.	BT-2	Understanding
6.	A strip footing 2m wide carries a load intensity of 400 kN/m2 at a depth of 1.2 m in sand. The saturated unit weight of sand is 19.5 kN/m3 and unit weight above water table is 16.8 kN/m3. The shear strength parameters are C=0 and Φ = 350 . Determine the factor of safety with respect to shear failure for the following cases of location of water table (a) Water table is 4m below G.L (b) Water table is 1.2 m below G.L (c) Water table is 2.5 m below G.L (d) Water table is 0.5 m below G.L (e) Water table is G.L itself	BT-3	Applying
7.	Discuss about the Plate load test for determining the Bearing capacity of foundation and How do you estimate the settlement of a footing on sand using the results of a plate load test?	BT-4	Analyzing
8.	An infinite slope made of soil with c' =20 kPa, ϕ = 20°, e = 0.65 and G=2.7 is 10m high. The slope angle is 25°. Find the factor of safety with respect to height for the following conditions a. When the soil is dry b. When the slope issubmerged.	BT-1	Remember
9.	List the techniques used to improve the stability of slopes in brief.	BT-1	Remember
10.	i. Explain Taylor"sstabilitynumber. (6) ii. Outline some of the uses of Taylor"s charts and its applicability. (7)	BT-2	Understand
11.	i. A slope is to be constructed at an inclination of 30° with the horizontal. Determine the safe height of the slope at factor of	BT-3	Apply

	safety of 1.5. The soil has the following properties.c=15 kN/m^2,ϕ =22.5°, γ = 20 kN/m^2 (S_n=0.046). (6) ii. Develop some points on total stress method ofanalysisof stabilityofslopes. (7)		
12.	i. Develop points on differences between finite and infinite slope. (6) ii. Build up points on FOS of a finite slope possessing both cohesion and friction(c - ϕ) by methodofslices. (7)	BT-3	Apply
13.	An embankment of 10m high is inclined at 35°to the horizontal. A stability analysis by method of slices gives the following forces: Total normal forces = 900 kN; total tangential force = 420 kN; total neutral force= 200kN. If the length of the failure arc is 23m, examine the FOS with respect to shear strength. The soil has C= 20 kN/m^2 and ϕ = 15°.	BT-4	Analyze
14.	Analyze the stability of soil using friction circle method with neat sketch.	BT-4	Analyze
	PART C		
1.	Explain terzaghi's analysis of bearing capacity of soil in general shear failure with assumptions.	BT-2	Understand
2.	A footing of 3m x 3m is to be constructed at a site at a depth of 1.5 m below ground level. The water table is at the base level of foundation. The average static cone penetration resistance obtained at the site is 20 kg/m2 . The soil is cohesive determine the safe bearing capacity for a settlement of 40 mm.	BT-5	Evaluating
3.	Briefly explain about the method of analysis of finite slopes.	BT-2	Understand
4.	A cut 9 m deep is to be made in clay with a unit weight of 18 kN/m^3 and cohesion of 27 kN/m^2. A hard Stratum exists at a depth of 18 m below the ground surface. Determine from Taylor"scharts ifa300slopeisSafe.Ifafactorofsafetyof1.50isdesired, examine the safe angle of slope?	BT-4	Analyze

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