SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF CIVIL ENGINEERING

QUESTION BANK

V SEMESTER

1903504 – FOUNDATION ENGINEERING

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UNIT 1- SITE INVESTIGATION AND SELECTION OF FOUNDATION

Scope and objectives – Methods of exploration – Auguring and boring – Wash boring and rotary drilling – Geophysical methods_ Depth and spacing of bore holes – Soil samples – Representative and undisturbed – Sampling methods – Split spoon sampler, Thin wall sampler, Stationary piston sampler – Penetration tests (SPT and SCPT) – Data interpretation - Strength parameters - Bore log report and Selection of foundation. based on soil condition

PART A

Q.NO	QUESTIONS	BT LEVEL	COMPETENCE
1.	Recall the various methods of soil exploration techniques.	BT-1	Remembering
2.	Identify why corrections are applied to SPT N-value.	BT-2	Understanding
3.	Define depth of exploration.	BT-1	Remembering
4.	State the merits and demerits of wash boring.	BT-1	Remembering
5.	List the different objectives of site investigation.	BT-1	Remembering
6.	Define Auger boring.	BT-1	Remembering
7.	Relate to decide the considerations made while deciding on the depth of exploration.	BT-3	Applying
8.	List the various types of boring.	BT-1	Remembering
9.	Describe about standard penetration number.	BT-2	Understanding
10.	Examine the disadvantages of wash boring.	BT-2	Understanding
11.	Summarize the functions of drilling mud.	BT-2	Understanding
12.	Summarize on the data interpretation made from soil exploration.	BT-2	Understanding
13.	Compare thick wall and thin walled sampler.	BT-2	Understanding
14.	Build points on the different types of samplers.	BT-3	Applying
15.	Identify the various parameters affecting the sampling disturbance.	BT-3	Applying
16.	Develop points on the advantages of SCPT over SPT.	BT-3	Applying
17.	Explain about recovery ratio of a sample.	BT-1	Remembering
18.	Compare about disturbed & un-disturbed samples.	BT-2	Understanding
19.	Interpret the factors on deciding the depth of soil exploration.	BT-3	Applying
20.	List the uses of Bore log report.	BT-2	Understanding
21.	List the limitations of static cone penetration test.	BT-2	Understanding
22.	Compare representative and non-representative. samples.	BT-2	Understanding
23.	Explain about area ratio and give the acceptable range of area ratios for soft and stiff soils.	BT-3	Applying

24.	The internal diameter of a sampler is 50 mm and the external diameter is 52 mm. Discuss the sample obtained from the sampler is disturbed or undisturbed.	BT-2	Understanding
25.	Discuss about dilatancy correction of soils.	BT-2	Understanding
PART B			
1.	A 70 storey building has an imprint of 35mx 25 m and will be supported on a mat foundation located at a depth of 10m. How many boring would you propose and to what depth? Where would you place the boring on the building plan view?	BT-4	Analyzing
2.	Demonstrate are the various factors affecting quality of samples. Explain the various types of samples.	BT-3	Applying
3.	Explain the salient features of a good sub- soil investigation.	BT-4	Analyzing
4.	Infer on any two methods of site exploration and explain its procedure in detail.	BT-4	Analyzing
5.	Outline about the various types of boring with neat sketches.	BT-2	Understanding
6.	Illustrate with neat sketch about the electrical conductivity method of soil exploration.	BT-3	Applying
7.	Summarize about (i) Bore log (3) (ii) Geophysical methods of soil exploration (7) (iii) Factors deciding number and depth of bore holes. (3)	BT-2	Understanding
8.	Build up points on various requirements to be met in order to achieve undisturbed samples in non-cohesive and cohesive soil.	BT-4	Analyzing
9.	When is the field static cone penetration test is applied and explain the same in detail.	BT-4	Analyzing
10.	Describe the principle and procedure for conducting sub soil exploration study using seismic refraction method.	BT-3	Applying
11.	Explain in detail the standard penetration test .Examine also the corrections to be applied on the observed SPT ‘N’ Value.	BT-4	Analyzing
12.	Explain wash boring method of advancing bore hole with a neat sketch and highlight the limitations of the method.	BT-4	Analyzing
13.	(i) Explain the arrangements and operations of stationary piston sampler. State its advantage over other samplers. (9) (ii) Write short notes on rotary samplers. (4)	BT-2	Understanding

<table>
<tr><td>14.</td><td>(i) Determine the area ratio for the following soil samplers and comment on the nature of the samples obtained in each of the samplers. (7)
<table>
<tr><th>S.No.</th><th>Sampler type</th><th>Outer diameter (mm)</th><th>Inner diameter (mm)</th></tr>
<tr><td>1.</td><td>Core cutter</td><td>165</td><td>150</td></tr>
<tr><td>2.</td><td>Split barrel</td><td>51</td><td>35</td></tr>
<tr><td>3.</td><td>Shelby</td><td>51</td><td>48</td></tr>
</table>(ii) Explain the inside clearance and outside clearance for samplers. (6)</td><td>BT-5</td><td>Evaluating</td></tr>
<tr><td>15.</td><td>Illustrate and explain the static cone penetration test procedure and list out its limitations.</td><td>BT-4</td><td>Analyzing</td></tr>
<tr><td>16.</td><td>Explain the salient features of a bore log report.</td><td>BT-4</td><td>Analyzing</td></tr>
<tr><td>17.</td><td>(i) The field N value in a deposit of fully submerged fine sand was 40 at a septh of 6m. The average saturated unit weight of the soil is 19 kN/m^3. Calculate the corrected N value as per IS: 2131-1981. (8)
(ii) Develop points on the precautionary measures in the execution of SPT. (5)</td><td>BT-5</td><td>Evaluating</td></tr>
<tr><td colspan="4">PART-C</td></tr>
<tr><td>1.</td><td>Infer on the corrections made on SPT ‘N’ values recorded in sand at different depths for overburden and submergence. How are these corrections applied?</td><td>BT-4</td><td>Analyzing</td></tr>
<tr><td>2.</td><td>Distinguish between non-representative, representative and undisturbed samples and name the various laboratory tests that could be conducted in each of these samples.</td><td>BT-4</td><td>Analyzing</td></tr>
<tr><td>3.</td><td>Summarize on any two methods of indirect soil exploration techniques and explain its procedure with neat sketch.</td><td>BT-5</td><td>Evaluating</td></tr>
<tr><td>4.</td><td>Explain about
(i) Selection of Foundation based on soil condition. (5)
(ii) Data interpretations from a bog log. (5)
(iii) Uses of soil exploration. (5)</td><td>BT-4</td><td>Analyzing</td></tr>
<tr><td>5.</td><td>(i) Recommend on the consideration and guidelines to be followed while deciding the depth and spacing of boring. (8)
(ii) Prepare a bore log of your own with all salient features incorporated (7)</td><td>BT-5</td><td>Evaluating</td></tr>
</table>

UNIT 2- SHALLOW FOUNDATION

Location and depth of foundation – Codal provisions – Bearing capacity of shallow foundation on homogeneous deposits – Terzaghi's formula and BIS formula – Factors affecting bearing capacity – Bearing capacity from in-situ tests (SPT, SCPT and plate load) – Allowable bearing pressure – Seismic considerations in bearing capacity evaluation. Determination of Settlement of foundations on granular and clay deposits – Total and differential settlement – Allowable settlements – Codal provision – Methods of minimizing total and differential settlements.

PART A

Q.NO	QUESTIONS	BT LEVEL	COMPETENCE
1.	Differentiate between local shear failure and general shear failure.	BT-2	Understanding
2.	Define the term Settlement.	BT-1	Remembering
3.	Distinguish between uniform settlement and differential settlement.	BT-2	Understanding
4.	Discuss about secondary compression settlement.	BT-2	Understanding
5.	Write the procedure to find effective dimension of an eccentrically loaded footing.	BT-3	Applying
6.	Differentiate between primary consolidation and secondary consolidation.	BT-2	Understanding
7.	In what way the punching shear failure differs from general shear failure.	BT-3	Applying
8.	Compare shallow foundation with deep foundation.	BT-2	Understanding
9.	Summarize safe bearing capacity and allowable bearing capacity.	BT-2	Understanding
10.	Classify the components of settlement.	BT-2	Understanding
11.	Distinguish between gross bearing capacity and net bearing capacity.	BT-2	Understanding
12.	Illustrate the load settlement characteristics of different shear failure modes.	BT-3	Applying
13.	Describe the different modes of shear failure.	BT-2	Understanding
14.	Construct the equation to obtain immediate settlement and consolidation settlement.	BT-3	Applying
15.	Identify the limitations of plate load test.	BT-1	Remembering
16.	List the factors considered in seismic design of shallow foundation.	BT-1	Remembering
17.	Compare immediate settlement and consolidation settlement.	BT-2	Understanding
18.	List the factors affecting Bearing capacity.	BT-1	Remembering
19.	Interpret the requirements of good foundation.	BT-3	Applying
20.	Produce the assumptions made in Terzaghi's bearing capacity analysis.	BT-3	Applying
21.	Formulate the Terzaghi's equation.	BT-1	Remembering
22.	Discuss on the limitations made in Terzaghi's bearing capacity analysis.	BT-1	Remembering

23.	Determine the immediate settlement under the foundation of dimension 12 m x 24 m that exerts a pressure of 150 kN/m in sand. The value of E for sand is 60x 10^3 kN/m^2.Take I_s = 1 and Poisson's ratio as 0.5.	BT-5	Evaluating
24.	Discuss the factors to be considered while designing the foundation.	BT-2	Understanding
25.	Estimate the effect of water table on the bearing capacity of soil when located at the ground level itself.	BT-5	Evaluating
	PART B		
1.	A square footing 2.5 m by 2.5 m is built in a homogeneous bed of sand of unit weight 20 kN/ m^3 and having an angle of shearing resistance of 360. The depth of the base of footing is 1.5 m below the ground surface. Find the safe load that can be carried by a footing with a factor of safety of 3 against complete shear failure. Use Terzaghi's analysis.	BT-5	Evaluating
2.	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/m^3 Factor of safety 2.4? Angle of internal friction 33° by IS code.	BT-5	Evaluating
3.	Illustrate the elastic and plastic equilibrium zones according to Terzaghi's bearing capacity analysis. Also, relate the forces acting during the verge of failure.	BT-3	Applying
4.	The load settlement curve data from a plate load test on a sandy soil are as under : Load, t/m^2: 10, 20, 30, 40, 50, 60, 70, 80 Settlement, mm: 4.5, 10, 15.5, 22, 29, 38.5, 50, 64 The size of the plate used was 0.3m x 0.3 m. Find the size of the square column footing to carry a net load of 250 t with a maximum settlement of 25mm.	BT-4	Analyzing
5.	A square footing located at a depth of 1.5 m below the ground surface in Cohesion less soil carries a column load of 1280 kN. The soil is submerged having an effective unit weight of 11.5 kN/m^3 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-3	Applying

Table for question 4:

Load, t/m^2	10	20	30	40	50	60	70	80
Settlement, mm	4.5	10	15.5	22	29	38.5	50	64

6.	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 as 1.9 gm/ c.c. and Nc = 5.7, Nq = 1 and Nγ = 0.	BT-5	Evaluating
7.	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/m^3. Also, calculate the safe bearing capacity of factor at a safety of 3.	BT-4	Analyzing
8.	Calculate the Safe bearing capacity per unit area of (i) a strip footing 1 m wide (4) (ii) a square footing 3m x 3m (3) (iii) a circular footing of 3m diameter. (3) (iv) a rectangular footing of 1.3x 2.2 m. (3) Unit weight of the soil 1.8 t/m^3, cohesion = $2t/m^2$ And Φ = 20^0, Nc = 17.5, Nq = 7.5 and N γ = 5. Depth of footing is 1.6m below ground surface.	BT-3	Applying
9.	A strip footing 2m wide carries a load intensity of 400 kN/m^2 at a depth of 1.2 m in sand. The saturated unit weight of sand is 19.5 kN/m^3 and unit weight above water table is 16.8 kN/m3. The shear strength parameters are C=0 and Φ = 35^0. 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

10.	A strip footing is to carry a load of 750kN/m at a depth of 1.6m in a cohesive soil having unit weight of 18kN/ m^3& C=20kN/ m^2 and angle of internal friction is 25 degree. Determine the width of footing, using F.O.S as 3. Use Terzhagi's equations. Nc = 25.1, Nq = 12.7 and $N\gamma$ = 9.7	BT-3	Applying
11.	Discuss about the Plate load test for determining the bearing capacity of foundation and infer on the estimation of the settlement of a footing on sand using the results of a plate load test.	BT-4	Analyzing
12.	(i) An RCC foundation of size 18m x 36m have a uniform pressure of 180kN/m^2 on a soil mass with modulus of elasticity 45kN/m^2. Determine the immediate settlement of the foundation. Assume poisons ratio as 0.5. (5) (ii) Explain in detail the characteristics of immediate settlement and consolidation settlement. (8)	BT-4	Analyzing
13.	Explain the following modes of shear failure, (i) General shear failure (4) (ii) Local shear failure (4) (iii) Punching shear failure (5)	BT-4	Analyzing
14.	(i) A rectangular footing 3m x 2m exerts a pressure of 100kN/m^2 on a cohesive soil Es= 5x104 kN/m^2 and μ = 0.5. Estimate the immediate settlement at the centre, assuming (a) the footing is flexible (5) (b) the footing is rigid (5) (ii) Write about influence of water table in determination of bearing capacity. (3)	BT-5	Evaluating
15.	Explain the procedure to interpret the bearing capacity from standard penetration test and static cone penetration test?	BT-3	Applying

<table>
<tr>
<td>16.</td>
<td>The following data was obtained from a plate load test carried out on a 60 cm square test plate at a depth of 2 m below ground surface on a sandy soil which extends upto a large depth. Determine the settlement of a foundation 3.0 m x 3.0 m carrying a load of 110t and 220t, located at a depth of 3m below the ground surface.
<table>
<tr><td>Load intensity, t/m^2</td><td>5</td><td>10</td><td>15</td><td>20</td><td>25</td><td>30</td><td>35</td><td>40</td></tr>
<tr><td>Settlement, mm</td><td>2.0</td><td>4.0</td><td>7.5</td><td>11</td><td>16.3</td><td>23.5</td><td>34</td><td>45</td></tr>
</table>
</td>
<td>BT-3</td>
<td>Applying</td>
</tr>
<tr>
<td>17.</td>
<td>(i) Evaluate the effect of water table on bearing capacity of soil. (7)
(ii) Determine the depth at which a circular footing of 2 m diameter be founded to provide a factor of safety of 3, if it has to carry a safe load of 1600kN. The foundation soil has $c = 10\ kN/m^2$, $\phi = 30^\circ$ and unit weight = $18\ kN/m^3$. Use Terzaghi's analysis. (8)</td>
<td>BT-5</td>
<td>Evaluating</td>
</tr>
<tr>
<td colspan="4">PART-C</td>
</tr>
<tr>
<td>1.</td>
<td>(i) In the field, a soft normally consolidated clay layer exists for a thickness of 20m. The natural water content, specific gravity of solids and the liquid limit of the clay are 40%, 2.7 and 60 % respectively. The ground water table is at the surface and the saturated unit weight is $19.80\ kN/m^3$. The vertical stress increment at the center of the clay layer due to the foundation load is $10 kN/m^2$. Estimate the settlement of the foundation. (10)
ii) Explain the factors governing the location and depth of foundation. (5)</td>
<td>BT-1</td>
<td>Remembering</td>
</tr>
<tr>
<td>2.</td>
<td>Explain Terzaghi's analysis of bearing capacity of soil in general shear failure with assumptions.</td>
<td>BT-2</td>
<td>Understanding</td>
</tr>
<tr>
<td>3.</td>
<td>(i) 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 $20\ kg/m^2$. The soil is cohesive determine the safe bearing capacity for a settlement of 40 mm. (7)
(ii) Infer on the IS code method of computing bearing capacity of soil. (8)</td>
<td>BT-5</td>
<td>Evaluating</td>
</tr>
</table>

4.	A footing 2 m square, rests on a soft clay soil with its base at a depth of 1.5 m from ground surface. The clay stratum is 3.5 m thick and is underlain by a firm sand stratum. The clay soil has LL=30%, G=2.7, water content at saturation = 40 %, cohesion = 0.5 kg/cm^2 ($\Phi = 0$). It is known that the clay stratum is normally consolidated. Compute the settlement that would result if the load intensity is equal to safe bearing capacity of soil was allowed to act on the footing. Natural water table is quite close to the ground surface. For given conditions, bearing capacity factor (N_c) is obtained as 6.9. Take factor of safety as 3. Assume load spread of 2(vertical) to 1 (horizontal).	BT-6	Creating
5.	Explain in detail the load settlement curves obtained by plate load test for various types of soil. Also, list out the limitations of plate load test.	BT-4	Analyzing

UNIT 3- FOOTINGS AND RAFTS
Types of Isolated footing, Combined footing, Mat foundation – Contact pressure and settlement distribution – Proportioning of foundations for conventional rigid behaviour – Minimum thickness for rigid behaviour Applications – Compensated foundation – Codal provision

PART – A

1.	Where can be the raft or mat foundation adopted?	BT-1	Remembering
2.	What is the condition for selecting the critical section to check diagonal shear and punching shear of a spread (or) isolated footing?	BT-2	Understanding
3.	Discuss on the reduction of differential settlements by adopting mat foundation.	BT-2	Understanding
4.	Recall on cantilever footing.	BT-1	Remembering
5.	Under which circumstances raft foundation is preferred?	BT-2	Understanding
6.	What do you mean by buoyancy raft foundation?	BT-1	Remembering
7.	Furnish the situation under which combined footings will be adopted.	BT-2	Understanding
8.	State the requirement of a good foundation.	BT-1	Remembering
9.	Differentiate rigid and elastic foundation.	BT-2	Understanding
10.	Based on function and design, classify types of various footings adopted.	BT-2	Understanding
11.	Compare strip footing and strap footing.	BT-2	Understanding
12.	Describe about floating foundation.	BT-1	Remembering
13.	Identify the seismic force and its consideration on footings.	BT-3	Applying
14.	Illustrate the principle behind floating foundation.	BT-3	Applying
15.	Summarize the concept of contact pressure distribution.	BT-3	Applying
16.	Sketch the critical region of eccentricity.	BT-5	Evaluating
17.	What are the advantages of combined footing.	BT-4	Analysing
18.	Infer the situation for which strap footing is preferred.	BT-2	Understanding
19.	Draw the pressure distribution diagram of a trapezoidal footing along with proportioning.	BT-3	Applying
20.	Mention the assumptions made in the conventional method of design of raft foundation.	BT-1	Remembering
21.	Explain the concept of bulb of pressure in footings.	BT-1	Remembering
22.	Assess the condition for selecting the critical section for bending moment of a spread or isolated footing.	BT-5	Evaluating
23.	Draw the contact pressure distribution diagram below rigid footing resting	BT-2	Understanding

	on clay and sand.		
24.	List out the types of mat foundation.	BT-1	Remembering
25.	Discuss the need for Rectangular or trapezoidal footings.	BT-2	Understanding

PART – B			
1.	Show the step by step procedure of proportioning of trapezoidal combined footing with neat sketch.	BT-3	Applying
2.	Prepare short notes on the following (i) Seismic considerations in foundation design (6) (ii) Design procedure of strip footing. (7)	BT-3	Applying
3.	Explain the procedure for the design of spread or isolated footings.	BT-2	Understanding
4.	Show the procedure for proportioning and designing of the rectangular combined footing with neat sketch	BT-3	Applying
5.	Describe the following (i) Proportioning and designing of the strap footings. (7) (ii) Pressure distribution beneath foundation. (6)	BT-3	Applying
6.	A trapezoidal footing is to be produced to support two square columns of 30 cm and 50 cm sides respectively. Columns are 6 meters apart and the safe bearing capacity of the soil is 400 kN/m^2 The bigger column carries a load of 5000 kN and the smaller carries a load of 3000 kN. Analyse and design a suitable size of the footing so that if does not extend beyond the face of the columns.	BT-5	Evaluating
7.	Explain the conventional methods of proportioning of raft foundation.	BT-3	Applying
8.	Briefly discuss about the various types of footing with neat sketch.	BT-2	Understanding
9.	Plan and compute a mat foundation with 9 columns. Assuming the mat is rigid, determine the soil pressure distribution. All the columns are of size 0.6 m x 0.6 m. Assume relevant loads on column as per IS standards.	BT-5	Evaluating
10.	Design a RCC footing for a wall 30 cm wide and having a load of 80 kN/m The allowable soil pressure is 50 kN/m^2.	BT-5	Evaluating
11.	(i) Explain the types of mat foundation. (7) (ii) List the application and conditions where mat foundations are used. (6)	BT-2	Understanding
12.	Proportion a rectangular combined footing for two columns 5 m apart. The exterior column of size 0.3 m x 0.3 m carries a load of 600 kN and interior column of size 0.4 m x 0.4 m carries a load of 900 kN. The allowable soil pressure is 100 kN/m^2	BT-5	Evaluating

13.	Write brief notes on: (i) Mat foundation (7) (ii) Floating foundation (6)	BT-2	Understanding
14.	Analyze the methods to compute the minimum thickness of rigid footing.	BT-4	Analyzing
15.	Design a rectangular combined footing for two columns having column load of 600 kN and 900 kN. Take the net allowable pressure as 100 kN/m^3.	BT-6	Creating
16.	Design a trapezoidal footing of 2 columns of size 0.5 m x 0.5 m with the centre to centre spacing 6 m. The load on the columns are 2000kN and 1500kN respectively. Take the net allowable bearing pressure as 200 kN/m^2.	BT-6	Creating
17.	Design a strap footing for the two columns of size 0.4 x 0.4 m carrying a load of 600 and 1000kN. The allowable soil pressure is 100 kN/m^2 Take eccentricity of the footing of column carrying 600 kN as 1m. The columns are spaced at 6 m c/c.	BT-4	Analyzing
	PART – C		
1.	Asses the IS codal provisions and recommendations for the design of raft foundation.	BT-5	Evaluating
2.	Explain with neat sketch the types of raft foundation and also mention their applications.	BT-3	Applying
3.	Critically discuss the choices of different shallow foundations with different site conditions. State the merits and demerits of each foundation type.	BT-2	Understanding
4.	(i) Explain the design procedure of a combined footing (8) (ii) Describe about contact pressure for foundations on clay and sand. (7)	BT-4	Analyzing
5.	Discuss in detail about the seismic considerations for a footing design.	BT-2	Understanding

UNIT 4 - DEEP FOUNDATION
Types of piles and their functions – Factors influencing the selection of pile – Carrying capacity of single pile in granular and cohesive soil – Design methodology for piles - Static formula – Dynamic formulae (Engineering news and Hileys) – Capacity from insitu tests (SPT and SCPT) – Negative skin friction – Uplift capacity-Group capacity by different methods (Feld's rule, Converse – Labarra formula and block failure criterion) – Settlement of pile groups – Interpretation of pile load test (routine test only), Under reamed piles – Capacity under compression and uplift– Cohesive – expansive – non expansive – Cohesionless soils – Codal provisions.

PART – A

1.	Where are the deep foundations employed?	BT-2	Understanding
2.	List the factors considered for the selection of pile type.	BT-1	Remembering
3.	How do you proceed to calculate the settlement of a group of friction piles in clay?	BT-3	Applying
4.	How to protect the pile during driving?	BT-1	Remembering
5.	Write Converse-Labarre formula for group efficiency of piles.	BT-1	Remembering
6.	Write about group action of piles and spacing of piles in group action.	BT-3	Applying
7.	What is meant by group settlement ratio?	BT-2	Understanding
8.	Identify the methods for estimating the load –carrying capacity of a pile.	BT-2	Understanding
9.	Report on reasons for conducting initial tests on piles.	BT-2	Understanding
10.	Define negative skin friction.	BT-1	Remembering
11.	What are the general forms of deep foundation?	BT-2	Understanding
12.	What are the different types of piles according to the material of construction?	BT-2	Understanding
13.	Describe about under reamed pile? When is it preferred?	BT-3	Applying
14.	State the methods of pile driving.	BT-1	Remembering
15.	State Feld's rule for determining group capacity of pile groups.	BT-1	Remembering
16.	Discuss the application of batter piles.	BT-2	Understanding
17.	What is the need of pressure piles?	BT-3	Applying
18.	List the different types of piles according to their functions.	BT-1	Remembering
19.	Examine the different types of piles according to its installation.	BT-1	Remembering
20.	What is the result of driving a displacement pile into a loose sand and plastic clay?	BT-3	Applying
21.	What are the precautions that should be taken to avoid heaving of soil while driving the pile?	BT-3	Applying
22.	Recall the Engineering News formula to calculate the load carrying capacity of	BT-1	Remembering

	pile.		
23.	Define pile cap.	BT-1	Remembering
24.	Discuss about Pile group efficiency and list the factors affecting pile group efficiency.	BT-3	Applying
25.	For a Pile designed for an allowable load of 4 kN driven by a single acting steam hammer with a energy of 221 t-cm. Estimate approximate terminal set of Pile.	BT-5	Evaluating

PART - B

1.	Define pile foundation. Briefly discuss about the type of pile and their functions.	BT-2	Understanding
2.	(i) A wooden pile is being driven with a drop hammer weighing 20 kN having a free fall of 1 m. The penetration in the last blow is 5 mm. Determine the load carrying capacity using engineering news formula. (7) (ii) Compare and contrast engineering news and Hileys formula (6)	BT-5	Evaluating
3.	Discuss the following methods of load carrying capacity of pile (i) Static formula (7) (ii) Dynamic formula (6)	BT-4	Analyzing
4.	Elaborate the following, (i) Under reamed piles (5) (ii) Negative skin friction (4) (iii) Pile Cap and Settlement of pile group in clay (4)	BT-2	Understanding
5.	(i) A concrete pile 30 cm diameter is driven into a medium dense sand (φ = 35°, γ = 21 kN/m^3), k = 1.0, tan δ = 0.7, N_q = 60). For a depth of 8m, Find the safe load. Taking a factor of safety of 2.5, if the water table rises to 2 m below the ground surface take γ_w = 10 kN/m^2. Assume necessary data if available (7) (ii) Classify the pile foundation based on method of installation and load transfer mechanism. (6)	BT-5	Evaluating
6.	A square concrete pile (30cm side) 10 m long is driven into coarse sand having γ = 18.5 kN/m^3 & N = 20. Determine the allowable load (F.S = 3.0).	BT-5	Evaluating
7.	A reinforced concrete piles weights 30 kN, is driven by a drop hammer weights 40 kN having an effective fall of 0.8 m. The average set per blow is 1.4 cm. The total temporary elastic compression is 1.8. Assuming coefficient of resistance as 0.25. Determine the safe load using	BT-5	Evaluating

	(i) Engineering News Formula (7) (ii) Hileys Formula (6)		
8.	(i) What is 'negative skin friction' on pile and why does it cause concern? How do you estimate its value in clay and sandy soil? Suggest means of controlling it. (7) (ii) Discuss the method of obtaining ultimate load and also allowable load on a single pile from pile load test. (6)	BT-4	Analyzing
9.	Design a square pile group to carry 400 kN in clay with an unconfined compressive strength of 60 kN/m^2 The piles are 30 cm diameter and 6 m long. Adhesion may be taken as 0.6	BT-5	Creating
10.	A 16 pile group has to be arranged in the form of a square in soft clay with uniform spacing. Neglecting end bearing, determine the optimum value of the spacing of the piles in terms of the pile assuming a shear mobilization factor of 0.6	BT-3	Applying
11.	(i) Determine the group capacity of 15 piles arranged in 3 rows of diameter 300 mm. If the piles are driven 8 m in to clay with cohesion 25 kN/m^2. Take spacing of piles as 0.8 m. (7) (ii) Discuss the method of obtaining ultimate load and also allowable load on a single pile from pile load test. (6)	BT-3	Applying
12.	Analyze the following (i) Group capacity of pile (7) (ii) Seismic consideration in pile design (6)	BT-4	Analyzing
13.	A square group of 25 piles extends between depth of 2m and 12m in a deposit of 20 m thick stiff clay overlying rock. The piles are 0.5 m in dia and are spaced at 1m centre to centre in the group. The undrained shear strength of the clay at the pile base level is 180 kPa and the average value of the undrained shear strength over the depth of the pile is 110 kPa. The adhesion coefficient α is 0.45. Estimate the capacity of the pile group considering an overall factor of safety equal to 3 against shear failure. N_c corresponding to $\varphi_u = 0$ is 9.	BT-3	Applying
14.	A group of nine piles of 300 mm diameter, spaced at 1m. Find the efficiency of pile group using Felds rule and Converse-Labarra formula.	BT-4	Analyzing
15.	Demonstrate about the interpretations obtained from the pile load test.	BT-3	Applying

16.	Explain the following, (i) Uplift capacity of pile (7) (ii) Construction of under-reamed piles. (8)	BT-2	Understanding
17.	Design a friction pile group to carry a load of 3000 kN including the weight of the pile cap at a site where the soil is uniform clay to a depth of 20m, underlain by rock. Average unconfined compressive strength of the clay is 70 kN/m^2. The clay may be assumed to be normal sensitivity and normally loaded, with liquid limit 60%. A factor of safety of 3 is required against shear failure.	BT-5	Evaluating

PART – C

1.	A group of 16 piles of 50 cm diameter is arranged with a center to center spacing of 1 m. The piles are 9 m long and are embedded in soft clay with cohesion 30 kN/m^2. Bearing resistance may be neglected for the piles. Adhesion factor is 0.6. Determine the ultimate load capacity of the pile group.	BT-5	Evaluating
2.	(i) Summarize the behavior of a group of piles in (a) sand and (b) clay, as compared to that of single pile in terms of the 'group efficiency factor'. (8) (ii) Explain the methods of determining load carrying capacity of a pile. (7)	BT-4	Analysing
3.	It is proposed to provide pile foundation for a heavy column: the pile group are circular having diameters 0.5m each and length as 10 m. Design the group pile of the conditions mentioned.	BT-5	Evaluating
4.	A group of nine piles, 12 m long and 250 mm in diameter, is to be arranged in a square form in a clay soil with an average unconfined compressive strength of 60 kN/m^2. Find the center to center spacing of the piles for a group efficiency factor of 1. Neglect bearing at the tip of the piles.	BT-3	Applying
5.	Explain in detail the procedure for pile load test to determine the load carrying capacity of pile.	BT-2	Understanding

UNIT 5- RETAINING WALLS
Introduction- Plastic equilibrium in soils – active and passive states – Rankine's theory – Cohesionless and cohesive soil – Coulomb's wedge theory – Condition for Critical failure plane – Earth pressure on retaining walls of simple configurations – Culmann Graphical method – pressure on the wall due to line load.

PART – A

1.	State Active and Passive Earth pressure.	BT-1	Remembering
2.	State whether the following statement is true or not and justify your answer. 'Retaining structures are mostly designed for active pressure and not for passive earth pressure'.	BT-1	Remembering
3.	Summarize coefficient of earth pressure.	BT-1	Remembering
4.	Enumerate the assumptions made in Rankine's theory.	BT-1	Remembering
5.	What is the critical height of an unsupported vertical cut in cohesive soil?	BT-2	Understanding
6.	List out the various assumptions involved in Coulomb's earth pressure theory.	BT-1	Remembering
7.	Compare Coloumb's wedge theory with Rankine's theory.	BT-2	Understanding
8.	Sketch the variation of earth pressure and coefficient of earth pressure with the movement of the wall	BT-4	Analyzing
9.	Give the minimum factor of safety for the stability of a retaining wall.	BT-1	Remembering
10.	If a retaining wall of 5 m high is restrained from yielding, what will be the total earth pressure at rest per metre length of wall? Given: the back fill is cohesion less soil having $\varphi = 30°$ and $\gamma = 18$ kN/m^3.	BT-3	Applying
11.	Make an estimate of lateral earth pressure coefficient on a basement wall supports soil to a depth of 2 m. Unit weight and angle of shearing resistance of retained soil are 16 kN/m^3 and 32° respectively.	BT-5	Evaluating
12.	Are granular materials are preferred for the backfill of a retaining wall? Justify.	BT-3	Applying
13.	How do tension cracks influence the distribution of active earth pressure in pure cohesion?	BT-2	Understanding
14.	Why lateral wall movement required for complete mobilization of passive state is higher than that for active state?	BT-2	Understanding
15.	What are different states in which a soil mass can exist?	BT-1	Remembering
16.	What do you understand by plastic equilibrium in soils?	BT-2	Understanding
17.	State critical failure plane.	BT-1	Remembering
18.	Write about surcharge angle.	BT-1	Remembering

19.	Discuss about earth pressure at rest	BT-2	Understanding
20.	If the Poisson's ratio of soil is 0.4. Find its coefficient of earth pressure at rest.	BT-5	Evaluating
21	Enumerate the assumptions made in coulomb wedge theory.	BT-1	Remembering
22	What are the stability conditions to be checked for the retaining wall?	BT-1	Remembering
23	Why the passive earth pressure is not consider in the design?	BT-2	Understanding
24	Define theory of plasticity.	BT-5	Evaluating
25	What is surcharge?	BT-1	Remembering

PART – B			
1.	A retaining wall is 4 metres high. Its back is vertical and it has got sandy backfill upto its top. The top of the fill is horizontal and carries a uniform surcharge of 85 kN/m^2. Dry density of soil = 18.5 kN/m^3. Moisture content of soil above water table = 12%. Angle of internal friction of soil = 30°, specific gravity of soil particles = 2.65. Porosity of backfill = 30%. The wall friction may be neglected. Determine the following . (i) Depth of zero tension crack (6) (ii) Active pressure acting on the wall (7)	BT-5	Evaluating
2.	Explain Rankine's Active earth pressure theory for cohesion less soil and cohesive soil.	BT-3	Applying
3.	A 4m high vertical wall supports a saturated cohesive soil $\varphi = 0$ with horizontal surface. The top 2.5m of the backfill has bulk density of 17.6 kN/m^3 and apparent cohesion of 15 kN/m^2 The bulk density and apparent cohesion of the bottom 1.5 m is 19.2 kN/m^3 and 20 kN/m^2 respectively. If tension cracks develop, what would be the total active pressure on the wall? Also draw the pressure distribution diagram.	BT-4	Analyzing
4.	(i) What are the different modes of failure of a retaining wall (6) (ii) Analyze the effect of line load on retaining wall. (7)	BT-2	Understanding
5.	A retaining wall of 6 m high has a saturated backfill of soft clay soil. The properties of the clay soil are γ sat = 17.56 kN/m^3, unit cohesion Cu = 18 kN/m^2. Determine (i) the expected depth of tensile crack in the soil. (ii) the active earth pressure before the occurrence of tensile crack. (iii) the active pressure after the occurrence of tensile crack.	BT-3	Applying
6.	A wall of 8 m height retains sand having a density of 1.936 Mg/m^3 and angle of internal friction of 34°. If the surface of the backfill slopes upwards at 15°	BT-4	Analyzing

	to the horizontal, find the active thrust per unit length of the wall. Use Rankine's conditions.		
7.	A retaining wall has a vertical back and is 10m high. The soil is sandy loam of unit weight 20 kN/m^3.It shows a cohesion of 12 kN/m^2 and φ = 20°. Neglecting wall friction, determine the thrust on the wall. The upper surface of the fill is horizontal.	BT-4	Analyzing
8.	A smooth rigid retaining wall of 6 m high carries a uniform surcharge load of 12 kN/m^2. The backfill is clayey sand possessing the following properties. γ = 16.0 kN/m^3, φ = 25°, and c = 6.5 kN/m^2 for a retaining wall system, the following data were available: (i) Height of wall = 7 m. (ii) Properties of backfill: γd =16 kN/m3, φ = 35 ° (iii) Angle of wall friction, δ =20° (iv) Back of wall is inclined at 20° to the vertical (positive batter) (v) Backfill surface is sloping at 1:10. Find the following (i) Active earth pressure (ii) Passive earth pressure	BT-5	Evaluating
9.	Prepare a short note on i) Plastic equilibrium of soils. ii) Stability of retaining wall.	BT-2	Understanding
10.	Discuss in details on the method of estimating the active earth pressure on a retaining wall by using the Culmann's method.	BT-4	Analyzing
11.	Summarize the following (i) Depth of Tension Crack (ii) Economical design of Retaining Walls. (iii) Nature and magnitudes of earth pressures	BT-2	Understanding
12.	Give a brief note on the following with variation of pressure distribution (i) Cantilever Retaining Wall (ii) Counterfort Retaining Wall	BT-2	Understanding
13.	A retaining wall 6m height retains the backfill of bulk unit weight19 kN/m^3, C = 20 kN/m^3, angle of internal friction 30° and with the top horizontal. The backfill carries a surcharge of 30 kN/m^2 Compute the total active and passive earth pressure on the wall and their point of application. Draw the earth pressure distribution diagram.	BT-3	Applying
14.	A retaining wall 6m high retains sand with φ = 30° and unit weight 24kN/m^3upto the depth of 3 m from top. From 3 m to 6 m the material is	BT-3	Applying

	cohesive soil with c = 20kN/m^2 and φ = 20°. Unit weight of cohesive soil is 18 kN/m^3 A uniform surcharge of 100 kN/m^2 acts on top of the soil determine the total lateral pressure acting on the wall and its points of application.		
15.	Construct the determinations of active earth pressure according to Rankine's theory for the following conditions, (i) Submerged backfill (7) (ii) Backfill with uniform surcharge (8)	BT-3	Applying
16.	A retaining wall with a smooth vertical back is 10 m high and retains a two layer sand backfill with the following properties: 0 - 5 m depth: ϕ = 30˚, γ = 18 kN/m^3 Below 5 m : ϕ = 34˚, γ = 20 kN/m^3 Show the active earth pressure distribution assuming the water table is well below the base of wall.	BT-4	Analyzing
17.	A retaining wall 8 m high, with smooth vertical back, retains a clay backfill with c' = 15kN/m^2, ϕ = 15˚, γ = 18 kN/m^3. Calculate the total active thrust on the wall assuming that tension cracks may develop to the full theoretical depth.		

PART - C

1.	Discuss the Rankine's theories for various backfill conditions to calculate active earth pressure.	BT-3	Applying
2.	Construct a sketch and explain coulomb's wedge theory for soil pressure distribution.	BT-6	Creating
3.	Classify the different types of earth pressure? Give examples. Derive the an equation for determining the magnitude of earth pressure at rest	BT-3	Applying
4.	A retaining wall 10 m high retains a cohesionless soil having an angle of internal friction of 30^0. The surface of the soil is level with the top of the wall. The top 3 m of the fill has a unit weight of 20 kN/m^3 and that of the rest is 30 kN/m^3. Find the magnitude per metre run and point of application of the resultant active thrust. Assume φ the same for both the strata.	BT-4	Analyzing
5.	Explain the procedure to determine the active earth pressure using Culmann's graphical methods.	BT-5	Evaluating