UTTARAKHAND TECHNICAL UNIVERSITY, DEHRADUN

COLLEGE OF ENGINEERING ROORKEE

Name of Department	Civil Engineering
Course Title	Foundation Engineering
Subject Code	TCE-603

Details of the Course:

S.No.	Contents	Contact Hours
1.	**Introduction :** Role of civil engineer in the selection, design and construction of foundation of civil engineering structures, brief review of soil mechanics principles used in foundation engineering	**3**
2.	**Soil Exploration:** Methods of soil exploration; boring, sampling, penetration tests, correlations between penetration resistance and soil design parameters.	**4**
3.	**Earth Pressure and Retaining Walls :** Earth pressure at rest, active and passive earth pressure, Rankine and Coulomb's earth pressure theories, earth pressure due to surcharge, retaining walls, stability analysis of retaining walls, proportioning and design of retaining walls.	**6**
4.	**Foundations :** Types of foundations, mechanism of load transfer in shallow and deep foundations, shallow foundations, Terzaghi's bearing capacity theory, computation of bearing capacity in soils, effect of various factors, use of field test data in design of shallow foundations, stresses below the foundations, settlement of footings and rafts, proportioning of footings and rafts, sheeting and bracing of foundation excavation.	**11**
5.	**Pile Foundation:** Types and method of construction, estimation of pile capacity, capacity and settlement of group of piles, proportioning of piles.	**5**
6.	**Well Foundations:** Methods of construction, tilt and shift, remedial measures, bearing capacity, settlement and lateral stability of well foundation.	**4**
7.	**Slopes:** Mode of failure- mechanism, stability analysis of infinite slopes, methods of slices, Bishop's simplified method.	**5**
8.	**Machine Foundations:** Types of machine foundations, mathematical models, response of foundation – soil system to machine excitation, cyclic plate load test, block resonance test, criteria for design.	**4**

QUESTION BANKS

1. What do you infer from soil exploration and state it uses?
2. Discuss the different objectives of site investigation?
3. Formulate the merits and demerits of wash boring.
4. Explain Auger boring.
5. Discuss the factors affecting quality of samples?
6. Define the correction applied in SPT test.
7. Summarize the advantages of SCPT over SPT.
8. Write the different types of samplers.
9. The internal diameter of a sampler is 50 mm and the external diameter is 52 mm. Identify the sample obtained from the sampler as disturbed or undisturbed?
10. Summarize the following samplers with neat sketches: (i) Split spoon sampler.
    (ii) Thin walled sampler.
11. What is mean by dynamic cone penetration test and explain in detail about it.
12. Discuss about the Geophysical methods of site exploration?
13. Define Settlement.
14. What are the factors to be considered while designing the foundation?
15. Explain ultimate bearing capacity with the help of load settlement curve.
16. What are the Assumptions made in Terzaghi's Analysis?
17. State the limitations of Terzaghi's Analysis.
18. Compare shallow foundation with deep foundation.
19. A square footing 2.5 m by 2.5 m is built in a homogeneous bed of sand of unit weight 20 kN/m3 and having an anlge 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 aginst complete shear failure. Use terzaghi's analysis.
20. 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/m3 . What is the safe load if cohesion is 30kN/m3 Factor of safety 2.4. Angle of internal friction 33° by IS code.
21. Calculate the Safe bearing capacity per unit area of:
    1. a strip footing 1 m wide
    2. a square footing 3m x 3m

3. a circular footing of 3m diameter

4. a rectangular footing of 1.3x2.2m

Unit weight of the soil 1.8 t/m3 , cohesion = 2t/m^2 And $\Phi = 200$, Nc = 17.5, Nq = 7.5 and $N\gamma = 5$. Depth of footing is 1.6m below ground surface.

22. A strip footing 2 m 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 19.5Kn/m3 and unit weight above water table is16.8KN/m3. The shear strength parameters are c = 0 and $\Phi = 35o$. Determine the factor of safety with respect to shear failure for the following cases of location of water table. Determine the ultimate bearing capacity of the footing , if the ground water table is located (a) at a depth of 0.5 m below the ground surface,

    (b) at a depth of 0.5m below the base of the footing.

    (c) at the base of footing

    (d) at the ground level. Use Terzaghi theory.

23. (i) A rectangular footing 3m x 2m exerts a pressure of 100kN/m2 on a cohesive soil Es= 5x104 kN/m2 and $\mu = 0.5$. Estimate the immediate settlement at the centre, assuming (a) the footing is flexible (b) the footing is rigid

    (ii) Write about influence of water table in determination of bearing Capacity.

24. Under which circumstances Raft foundation is preferred?
25. Explain the concept of bulb of pressure in footings.
26. Illustrate the principle behind floating foundation.
27. Determine the dimension for strap footing for the two columns of 0.4 m x 0.4 m, allowable soil pressure is 100 kN/m2 . Distance between C/C two columns is 6 m. Take eccentricity of footing of column is 1 m. Assume necessary data if needed.
28. Describe about under reamed pile? When is it preferred?
29. What is meant by group settlement ratio?
30. Define Negative skin friction (or) down drag.
31. Discuss about Pile group efficiency and list the factors affecting pile group efficiency.
32. 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.

33. (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/m2 . Take spacing of piles as 0.8 m.

    (ii) Discuss the method of obtaining ultimate load and also allowable load on a single pile from pile load test.
34. Compare Coloumb's wedge theory with Rankines theory.
35. Is granular materials are preferred for the backfill of a retaining wall? Why?
36. Discuss about earth pressure at rest.
37. 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/m3 and apparent cohesion of 15 kN/m2 . The bulk density and apparent cohesion of the bottom 1.5 m is 19.2 kN/m3 and 20 kN/m2 respectively. If tension cracks develop, what would be the total active pressure on the wall? Also draw the pressure distribution diagram.
38. Discuss in details on the method of estimating the active earth pressure on a retaining wall by using the Culmann's method.

FOUNDATION ENGINEERING (TCE 602)

Unit I

1. Enumerate the scope and objectives of methods of soil exploration.
2. Enlist the following samplers with neat sketches (i) Split spoon sampler (ii) Thin walled sampler.
3. With a neat sketch, explain the types of boring (i) Auger boring (ii) Wash boring
4. Explain dynamic cone penetration test.
5. Give important parameters to fix the significant depth of exploration.

Unit II

1. Sketch the variation of the earth pressure and explain it for the following (i) Active state (ii) Passive State
2. Compute the intensities of active and passive earth pressure at depth of 8m in dry cohesion less sand with an angle of internal friction of 30° and unit weight of 18kN/m^3.

3. What are the assumptions in Coulomb's theory? Compare Rankine's theory and Coulomb's theory.
4. 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/m2. Determine the active earth pressure on the wall per metre length of wall. Water table is 1m below the top of the fill. Dry density of soil = 18.5 kN/m3. 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.
5. Explain the earth pressure at rest.
6. Explain Coulomb's Wedge Theory.

Unit III

1. Explain different types of the shear failures with suitable diagrams.
2. Define standard penetration test explaining its application in the foundation engineering.
3. Define different types of the footings with the help of neat sketches.
4. Explain : (a) Ultimate bearing capacity
   (b) Gross safe bearing capacity
   (c) Allowable bearing pressure
5. What are the factors affecting the bearing capacity of the soil?
6. Explain the plate load test.

7. A 2m wide strip footing is formed at a depth of 1.5m below the ground level in the homogeneous bed of dense sand having the following properties: $\varphi = 36°$, $\Upsilon = 1.85\ tm^3$. Determine the ultimate, net ultimate, net safe bearing capacity of the footing. Given N_c = 60, Nq= 42 and N Υ = 47. Assume F.O.S. of 3.
8. What are the different types of raft foundations?

Unit IV

1. Determine the group capacity of a pile group consisting of 10 piles (300mm dia) arranged in 2 rows, if the piles are driven 8m into clay with c= 25 kN/m^3 and pile spacing= 0.8m.

2. Explain different types of pile foundations.
3. Discuss any two type of dynamic formulae. What are their limitations.
4. Derive an expression for natural frequency of the free vibration system.
5. What are the various factors influencing the selection of pile?
6. A group of 16 piles of 50 cm diameter is arranged with a center to center spacing of 1.0 m. The piles are 9m long and are embedded in soft clay with cohesion 30kN/m. Bearing resistance may be neglected for the piles. Adhesion factor is 0.6. Determine the ultimate load capacity of the pile group.

Unit V

1. What is tilt and shift of a well? How it is rectified?
2. Describe the procedure for construction of wells. Discuss the causes and remedies for tilts and shifts.
3. Discuss in brief the type of samplers.
4. What are the situations where a pier or caisson may be used for foundation? Draw a neat sketch of well foundation and describe the problems associated with the sinking of well.
5. What are the various forces acting on well? Explain in detail.

Unit VI

1. Explain Taylor's stability number.
2. A cutting is to be made in clay for which the cohesion is 35 kN/m^2 and $\varphi = 0$. The density of the soil is 20 $kN/m^{2.}$ Find the maximum depth for cutting of side slope 3/2 to 1 if the F.O.S. is to be 1.5. Take the stability no. for 3/2 to 1 slope and $\varphi = 0$, $S_n = 0.17$.
3. What are the modes of slope failure? Also explain the Swedish Slip Circle Method.
4. Explain friction circle method.

Unit VII

1. What are the different types of machine foundations?
2. Explain: (a) Resonance
   (b) Damping
   (c) Frequency

3. Define the design criteria for foundations of reciprocating machines.
4. What is meant by vibration isolation? How is it done?