Total number of printed pages: 2 **UG/8th Semester/UCE 814**

2025

DESIGN OF SUBSTRUCTURES

Full Marks: 100

Time: Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

"Assumptions made should be clearly stated"
"Use of IS Code is permitted"
"Illustrate answers with real sketches whenever required"

1.	a)	What are the various types of foundations used in civil engineering field and also mention their uses? What are the requirements for selection of a proper type of foundation.	6+4=10
	b)	List the steps involved in a foundation design.	10
2.	a)	Calculate the net ultimate bearing capacity of a rectangular footing 2m x4m in plan, founded at a depth of 1.5 m below the ground surface. The load on the footing acts at an angle of 15^0 to the vertical and is eccentric in the direction of width by 15 cm. The saturated unit weight of soil is 18 kN/m^3. The rate of loading is slow and hence the effective stress shear strength parameters can be used in the analysis. Here, $c' = 15$ kN/m^3 and $\phi' = 25^0$. Natural water table is at a depth of 2.0 m below the ground surface. Use IS code recommendations.	10
	b)	Design a continuous footing for a brick wall of 40 cm thick transmitting a load of 150 kN/m. The allowable soil pressure is 100 kN/m^2. Assume unit of soil is is 17 kN/m^3. Use concrete with σ_{ck} = 15MPa and load factor = 1.5. The base of the footing lies at 0.5 m below the ground level. Use IS Code recommendations.	10
3.		Design a combined footing for two columns A (40×40 cm) and B (50×50 cm) respectively carrying axial loads of 900 kN and 1200 kN with a spacing of 4 m c/c. They are reinforced longitudinally with 20 mm bars. The property line is at a distance of 0.5 m from the center line of the column A. Allowable soil pressure of soil is 140 kN/m^2. Assume weight of footing and earth above as 10% of the total loads carried by the columns. Use M20 concrete mix and Fe 460 Grade steel.	20
4.	a)	Describe various steps involved in the design of piles.	10
	b)	It is required to support a tower on bored piles on a site where stiff fissured	10

<table>
<tr><td></td><td></td><td>clay is affected by seasonal swelling and shrinkage movements to a depth of 1.0 m. The unconfined compressive strength of stiff clay increases linearly from 40 kN/m^2 at 1.0 to 160 kN/m^2 at 8.0 m. design the pile assuming a total load = 2500 kN, and a F.O.S. equal to 3. Use IS code recommendations.</td><td></td></tr>
<tr><td>5.</td><td>a)</td><td>Determine the capacity of a 6.0 m long bored cast-in-situ pile in medium stiff clay having variation of undisturbed strength as given below:
<table>
<tr><th>Depth (m)</th><th>C_u (kN/m^2)</th></tr>
<tr><td>1.0</td><td>50</td></tr>
<tr><td>2.0</td><td>65</td></tr>
<tr><td>3.0</td><td>55</td></tr>
<tr><td>4.0</td><td>75</td></tr>
<tr><td>5.0</td><td>80</td></tr>
<tr><td>6.0</td><td>70</td></tr>
</table></td><td>10</td></tr>
<tr><td></td><td>b)</td><td>What are the loads and forces to be considered in designing the foundation of a bridge? How the allowable bearing pressure of a well foundation can be estimated as per IS code recommendation?</td><td>6+4=10</td></tr>
<tr><td>6.</td><td>a)</td><td>Explain the steps involved in the structural design of cantilever retaining wall.</td><td>10</td></tr>
<tr><td></td><td>b)</td><td>Write the design criteria for satisfactory performance of machine foundations. Derive the expressions for damping factor in the forced and free vibrations.</td><td>4+6=10</td></tr>
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