(3) Assumptions made should be **clearly** stated.
(4) Illustrate answers with **neat sketches** wherever **required.**

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1. (a) Describe Schmertmann method of determining settlement of footings in cohesionless soils. 6
   (b) Discuss the effects of shape and size of foundations on bearing capacity. 6
   (c) Describe with a neat labeled sketch the procedure of conducting the cyclic pile load to test separate skin friction and end bearing component. 8

2. (a) Explain Standard Penetration Test in detail. Explain the corrections to be applied to obtain the corrected values of SPN. What are the limitations of this test ? 10
   (b) Explain the procedure for conducting soil explorations for sandy soils in the field. State various field and laboratory tests to evaluate strength and deformation properties of sandy soils. 10

3. (a) Explain : Influence of roughness of the foundation base and ground inclination of footing on bearing capacity. 5
   (b) Explain the modes of failure in shallow foundations. 5
   (c) Calculate the net ultimate bearing capacity of a rectangular footing 2·2 m × 3·0 m in plan is placed at a depth of 1·50 m below GL. The properties of the soil are :— 10
   γ_{sat} = 1·80 t/m^3, ϕ = 30°, c = 1·0 t/m^2.
   The ground water table is located at 2·00 m below GL. Estimate the net ultimate bearing capacity as per IS : 6403-1981 recommendations.
   {**Hint :** $N_q = e^{\pi \tan\phi} \cdot \tan^2(45 + \phi/2)$, $N_c = (N_q - 1)\cot\phi$ and $N_\gamma = 2(N_q + 1)\tan\phi$}
   (Neglect the depth factors).

4. (a) What are the methods of estimating pre-consolidation pressure ? Explain any two methods in detail. 10
   What is Quasi pre-consolidation ?
   (b) State the assumptions in one-dimensional consolidation theory and derive the equation $\frac{\partial^2 u}{\partial z^2} = \frac{1}{c_v}\frac{\partial u}{\partial t}$, with usual notations. 10

5. (a) Define : Dilatancy and Critical void ratio. Briefly discuss the effect of drainage conditions on shear strength of clay. 10
   (b) The following data refers to a CU test, detennine effective shear parameters— 10
   (i) by drawing Mohr's circles, and
   (ii) by plotting modified failure envelope.

Cell pressure (kN/m^2)	100	200	300	400
Dev. stress at failure (kN/m^2)	65	130	200	268
Pore water pressure (kN/m^2)	52	105	162	213

6. (a) State the various methods of ground improvements. 10
   Explain 'stone columns' and 'sand drain with preloads' methods including basic principles and design approaches.
   (b) Calculate the stress at the center of an annular ring of diameter 3·6 metre and 2·8 metre carrying a load of 25 t/m^2 at a depth of 4·0 m below the loaded area. Also calculate the depth at which the stress reduces to 20% of applied load. 10

7. (a) Estimate the bearing capacity of a driven pile of 400 mm diameter into sandy strata. The length of the pile is 13·5 metre. Initial friction angle = 32°, after driving $\phi' = (\phi + 40)/2$ at base. Effective angle of friction along shaft is 32° (aver). Consider N_q = 35, K_s = 1·5, $\delta = 0.75^*\phi'$, γ_b = 16·4 kN/m^3, γ_{sat} = 18·7 kN/m^3. Water table is 3·0 m below GL. 10
   (b) Explain plate load test, as per IS : 1888-1982. Explain the methods to extrapolate 10