

**BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI**  
**II Semester 2022-2023**

**Course: CE F429 DESIGN OF FOUNDATION SYSTEM**  
**MID SEM. Examination (OPEN BOOK)**

**Duration: 90 min.**

**Dated: 15-03-2023**

**Max. Marks: 30**

**Attempt all questions.**

**Q1.** Design and detail a precast driven reinforced concrete circular pile (diameter = 0.5 m, Length = 10 m) subjected to a factored compressive load of 1750 kN and a factored moment of 220 kN-m. Use M35 mix concrete and Fe 500 grade steel. Assume  $d'/D=0.2$ . Transverse reinforcement spacing less than 60 mm is not permitted. Use minimum possible size of longitudinal and lateral reinforcements. Assume other data suitably as per Indian Standard. Draw neat sketch showing all details. **[8 marks]**

**Q2.** Find the safe thickness of the isolated rectangular footing by one-way shear (assume 0.5% steel), two-way shear and flexure for the column (size 400 mm x 500 mm) subjected to a factored axial force of  $P_u = 2480$  kN and factored moment of  $M_u = 1270$  kNm due to earthquake. Assuming 3.25 m length and 2.25 m width of foundation is worked out safe and the center of column coincides with the center of footing. Take M 25 grade concrete and 20 mm bars of Fe 500 grade steel for both footing and column. Assume clear cover 75mm. **[7 marks]**

**Q.3** A Ring footing of outer diameter 15 m and inner diameter 7.5 m is subjected to a direct compressive load of 50000 kN and a moment of 150000 kNm. Moment is due to Earthquake load. Draw the pressure distribution of the footing. Assume allowable soil pressure for the soil [SPT,  $N = 52$ ] is 600 kPa. Is it safe? Check. **[ 4 marks]**

**Q4.** A 2 m x 4 m rectangular footing constructed at depth of 1.5 m below ground level (G.L.) is subjected to a gross pressure of 200 kPa. The soil consists of deep deposit of sand having a unit weight of  $17 \text{ kN/m}^3$ . Water table is very deep from G.L. Find the settlement of foundation, using Schmertmann's (1978) approach. Average cone penetration resistance is given below. **[7 marks]**

|   |       |         |        |       |  |  |
|---|-------|---------|--------|-------|--|--|
| Depth from ground level (m)                       | 0-2.5 | 2.5-6.5 | 6.5-10 | 10-20 |  |  |
| Average CPT resistance $q_c$ (kN/m <sup>2</sup> ) | 3000  | 4500    | 6000   | 8000  |  |  |

**Q5.** A rectangular footing 4 x 6 m (designed for the column whose center coincides with the center of footing) is subjected to biaxial moments of  $M_y=1200$  kN-m (about an axis parallel to 4 m side and axis is passing through CG of footing) and  $M_x = 600$  kN-m (about an axis parallel to 6 m side and axis is passing through CG of footing) as well as vertical load of 1000 kN. Assess whether the footing is under tension or compression. Find the maximum pressure below foundation under applied loads. **[4 Marks]**

-Paper Ends-