

R18

Code No: 155DD

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, March - 2024

STRUCTURAL ENGINEERING - I (RCC)

(Civil Engineering)

Time: 3 Hours

Max. Marks: 75

Note: This question paper contains two parts A and B. i) **Part-A** for 15 marks, ii) **Part-B** for 60 marks.

- Part – A is a compulsory question consisting of ten sub-questions. The first five sub-questions are from each unit relating to design theory and codal provisions and carry 2 marks each. The next five sub-questions are from each unit and carry 1 mark each.
- Part – B consists of 5 questions (numbered 2 to 11) carrying **12 marks each**. Each of these questions is from one unit and may contain sub-questions. For each question there is either or choice, which means that there will be two questions from each unit and the student should answer either of the two questions.
- **Use of IS 456 and only design charts for columns are allowed.**

PART – A

(15 Marks)

- Determine the design load in collapse as per IS 456 for a dead load of 120 kN/m, live load 200 kN/m, wind load 20 kN/m, and earthquake load of 28 kN/m. [2]
- Distinguish between bond strength and bond force. [2]
- Why is it necessary to limit the crack widths? [2]
- List the primary factors influencing the strength and behavior of slender columns. [2]
- Explain the behaviour of combined footing for two columns. [2]
- The compressive strength of a standard 150 mm cube is 25 MPa, 31 MPa, 27 MPa, 20 MPa, and 38 MPa. Determine the characteristic strength of concrete. [1]
- Explain the reason for considering 'minimum eccentricity' for the design of columns. [1]
- Name the different types of two-way slabs. [1]
- What are the methods used for the columns subjected to bi-axial bending? [1]
- Under what circumstances are pile foundations preferred? [1]

PART – B

(60 Marks)

- Prove that the limiting moment of resistance 'Mu' of a singly (under) reinforced beam section using the stress block parameters of IS 456 is.

$$M_u = 0.87 f_y \left\{ \frac{p_t}{100} \right\} \left[1 - 1.005 \frac{f_y}{f_{ck}} \left\{ \frac{p_t}{100} \right\} \right] b d^2$$

Where percentage of steel $p_t = \frac{A_{st}}{bd} \times 100$ and lever arm (z) = $d - 0.416x_u$

- Determine whether the section shown in Figure 1 (dimensions are in mm) can withstand a factored moment of 100 kN-m. Use M30 grade concrete and Fe-415 steel. [6+6]

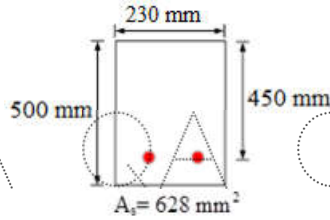


Figure 1

OR

3. A doubly reinforced rectangular concrete beam has a width of 230 mm and an effective depth of 480 mm. The beam is reinforced with 2000 mm² of steel in tension and 600 mm² of steel in compression. The effective cover for compression steel is 45 mm. Assume that both tension and compression steel yield. The grades of concrete and steel used are M30 and Fe-500, respectively. The stress block parameters for concrete shall be as per IS:456. Determine its moment of resistance. [12]

4. Design the shear reinforcement for a T-beam and slab system with beams spaced at 3 m center to center and a clear span of 6 m, supported by 300 mm brick walls. The T-beam (as shown in figure 2 - dimensions are in mm) carries a live load of 4 kN/m and is reinforced with four 20 mm diameter bars as longitudinal tension steel. Also, design the beam for a shear of 150 kN using M30 concrete and Fe-415 steel grade. [12]

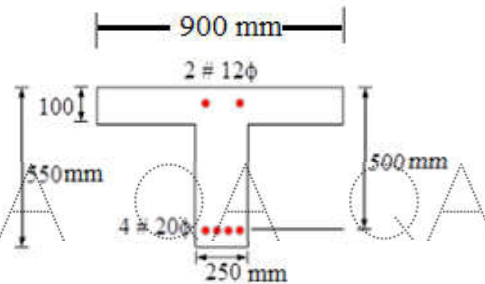


Figure 2

OR

5. Design a rectangular beam for a section 300 mm × 535 mm effective depth subjected to the following factored loads: a bending moment of 50 kN.m, shear of 50 kN, and torsion of 45 kN.m. Use M20 concrete and Fe 415 steel, design the reinforcements as per IS 456. Use an effective cover of 35 mm in your calculations. [12]

6. Design a rectangular slab panel 4.5 m × 6 m with one long edge being discontinuous. Consider the slab to supports an imposed load of 3.5 kN/m² and a floor finish of 1.5 kN/m². The slab is exposed to mild conditions and is constructed with M25 concrete and Fe 415 steel. [12]

OR

7. Determine the deflection at service loads for a three-span continuous beam with a rectangular section of 250 mm × 500 mm. Each span is 5 m long, and the beam is reinforced with three 16 mm bars at the supports, two 16 mm bars, and one 12 mm bar at mid-span. The beam is subjected to a live load of 12 kN/m and is made of M30 concrete and Fe-415 steel. [12]

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8. Design a short rectangular column subjected to a factored load of 2000 kN and a factored moment of 120 kN.m. Use M30 concrete and Fe-500 grade steel and mild environment.

[12]

QA QA QA QA OR QA QA QA

9. Design a short column with an unsupported length of 3.25 m under biaxial bending using the following parameters: Effective lengths $L_{ex} = 3$ m and $L_{ey} = 2.75$ m, column size of 400 mm × 600 mm, factored axial load $P_u = 2200$ kN, and factored moments $M_{ux} = 250$ kN.m and $M_{uy} = 150$ kN.m. Use of M30 concrete, Fe-500 steel, and consider a severe exposure environment.

[12]

QA QA QA QA QA QA QA

10. Design an isolated footing for a square column measuring 400 mm × 400 mm, supporting a service load of 2000 kN. Assume the safe bearing capacity (SBC) of the soil is 230 kN/m² at a depth of 1.5 m below the ground. Use M20 concrete and Fe-415 steel for the footing, and M30 concrete and Fe-500 steel for the column, which is reinforced with eight numbered 25 mm bars. Sketch the reinforcement details.

[12]

OR

- 11.a) What are the ultimate limit states that need to be checked during the structural design of footings?

QA QA QA QA QA QA QA

- b) Illustrate the reinforcement details with the help of a sketch commonly used in the design of combined footing for two columns.

[6+6]

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