

# CBCS SCHEME

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Fifth Semester B.E. Degree Examination, July/August 2021

## Design of RC Structural Elements

Time: 3 hrs.

Max. Marks: 100

- Note : 1. Answer any FIVE full questions.  
2. Use of IS : 456 – 2000 , SP16 is permitted.  
3. Assume suitable data, if necessary.

- 1 a. Explain the principles of limit state design. (06 Marks)  
b. Explain briefly under reinforced, over reinforced and balanced section with sketch. (06 Marks)  
c. A simply supported beam of rectangular section spanning 6m has a width of 300mm and overall depth of 600mm. The beam is reinforced with tensile steel of area  $1963\text{mm}^2$  with an effective cover of 50mm. Diameter of bars is 25mm spaced at 50mm centers. The beam is subjected to a moment of 160KN-m at centre of span. Check the beam for serviceability limit state of cracking. Assume  $f_{ck} = 25\text{ N/mm}^2$  and  $f_y = 415\text{ N/mm}^2$ . (08 Marks)
- 2 a. Write a brief note on :
  - i) Partial safety factors for materials.
  - ii) Characteristic loads.
  - iii) Characteristic strength.
  - iv) Partial safety factors for loads. (12 Marks)  
b. A simply supported beam of rectangular section spans over 10m and has an effective depth of 700mm. The beam is reinforced with 1% reinforcement on the tension side. Check for the deflection control of the beam by empirical method if :
  - i) Fe415 HYSD bars are used
  - ii) Fe500 HYSD bars are used. (08 Marks)
- 3 a. Derive from fundamentals the expression for the area of stress block  $0.36 f_{ck} X_u$ . (08 Marks)  
b. Determine the moment of resistance of T – beam for the following data :  
Width of the flange = 2500mm , Effective depth = 800mm , Width of Web = 300mm ,  
Depth of flange = 150mm , Number of bars = 8 of 25mm diameter. Assume  $M_{20}$  concrete and Fe415 steel. (12 Marks)
- 4 a. Derive the moment of resistance equation for doubly reinforced rectangular section. (10 Marks)  
b. A singly reinforced concrete beam of 250mm × 450mm deep upto the centre of reinforcement with 3 bars of 16mm diameter at an effective cover of 50mm, effective span of 6m. Use  $M_{20}$  concrete and Fe415 steel. Determine the central point load that can be supported in addition to the self weight. (10 Marks)
- 5 A reinforced concrete beam is to be designed over an effective span of 5m to support a design service load of 8 kN/m. Adopt  $M_{20}$  grade concrete and Fe415 HYSD bars and design the beam to satisfy the collapse and serviceability limit states. (20 Marks)
- 6 A T – beam slab floor of an office building comprises of a slab 150mm thick spanning between ribs spaced at 3m centres. The effective span of the beam is 8m. LL on the floor is  $4\text{ kN/m}^2$ . Using  $M_{20}$  concrete and Fe415 steel, design one of the intermediate T – beams. (20 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

- 7 Design a RCC slab for an office floor  $4.5\text{m} \times 5.5\text{m}$  with four edges discontinuous and corners held down. The LL on the slab is  $3\text{kN/m}^2$ . Assume floor finish as  $0.6\text{ kN/m}^2$  and ceiling finish as  $0.4\text{kN/m}^2$ . Use  $M_{20}$  grade concrete and Fe415 steel. Sketch the reinforcement. (20 Marks)
- 8 a. Distinguish between one way slab and two way slab. (04 Marks)  
b. Design a Dog legged stair for an office building in a room measuring  $2.8\text{m} \times 5.8\text{m}$ , clear distance between floors is  $3.6\text{m}$ . The width of the flight is to be  $1.25\text{m}$ . Assume Live load of  $3\text{kN/m}^2$ . Use  $M_{20}$  grade concrete and Fe415 steel. Assume that the stair supported on  $230\text{mm}$  at the outer edge of landing stairs. Sketch the reinforcement details. (16 Marks)
- 9 a. What is the role of transverse reinforcement in columns? What are the codal provisions to design transverse reinforcement? (06 Marks)  
b. Explain the difference between Short columns and Long columns. (04 Marks)  
c. A column size  $300\text{mm} \times 400\text{mm}$  has an effective length of  $3.6\text{m}$  and is subjected to  $P_u = 1100\text{kN}$  and  $M_u = 150\text{ kN m}$  about the major axis. Assuming the bars on two sides. Design the column using  $M_{25}$  concrete and Fe415 steel. (10 Marks)
- 10 Design an isolated footing for a rectangular column of  $300\text{mm} \times 500\text{mm}$  supporting an axial load of  $1500\text{ kN}$  factored. Assume SBC of soil as  $185\text{ kN/m}^2$ . Use  $M_{20}$  grade concrete and Fe415 steel. Sketch the reinforcement and perform the necessary checks. (20 Marks)

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