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## Fifth Semester B.E. Degree Examination, June/July 2023 Design of RC Structural Elements

Time: 3 hrs.

Max. Marks: 100

- Note:** 1. Answer any FIVE full questions, choosing ONE full question from each module.  
2. Use of IS456-2000 and SP(16) is permitted.  
3. Assume Suitable additional data, if necessary.

### Module-1

- 1 a. Distinguish between : i) Balanced section ii) Under reinforced section and iii) Over reinforced section with sketches. Which section is preferable and why? (10 Marks)  
b. What is stress block? Derive from the fundamentals the expression for the area of stress block  $0.36 f_{ck} b x_u$  and depth of centre of compressive force from the extreme fibre in compression  $0.42 \times x_u$ . (10 Marks)

OR

- 2 a. Explain : i) Short term deflection ii) Long term deflection iii) Side face reinforcement. (09 Marks)  
b. A cantilever of 3.5m span is 300mm wide and 600mm deep. If is subjected to a maximum bending moment of 125kN-m due to uniformly distributed service loads of which 50% moment is due to permanent loads. The beam is reinforced with 4 bars of 20mm diameter at an effective cover of 50mm in the tension zone. Determine the immediate deflection. Grades of concrete and steel  $M_{20}$  and  $F_{e415}$ . (11 Marks)

### Module-2

- 3 a. A singly reinforced beam (RCC) of 250mm  $\times$  450mm deep upto the center of reinforcement with 3 - #16 at an effective cover of 50mm, effective span of 6m.  $M_{20}$  concrete and  $F_{e415}$  steel. Determine the central point load that can be carried/supported in addition to the self weight. (12 Marks)  
b. Determine the moment of resistance of a T-beam for the following data :  
Effective depth = 400mm, Breadth of the flange = 740mm, Breadth of web = 240mm, Area of steel = 5 -# 20 and depth of flange = 110mm. Adopt  $M_{20}$  grade concrete and  $F_{e415}$  steel. (08 Marks)

OR

- 4 a. A doubly reinforced beam section is 300mm wide and 500mm deep to the centre of tensile reinforcement. It is reinforced with compression reinforcement of 300mm<sup>2</sup> at an effective cover of 50mm and tension reinforcement of 1800mm<sup>2</sup>. Determine the safe moment of resistance of the section.  $M_{20}$  grade concrete and  $F_{e500}$  grade steel is used. (12 Marks)  
b. A Tee beam has the following data:  
i) C/C spacing of beams = 3.2m  
ii) Simply supported effective Span = 8m  
iii) Depth of slab = 150mm  
iv) Size of web of beam = 300mm  $\times$  500mm  
Calculate the balanced moment of resistance. (08 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.

**Module-3**

- 5 a. Brief about codal provisions made in providing longitudinal and lateral reinforcement in beams. (05 Marks)
- b. A simply supported rectangular beam is supported on 300mm wide walls. Over a clear span of 6mtrs. Design the beam by using  $M_{25}$  grade concrete and Fe 415 Grade steel, superimposed load on beam is 15kN/m and breadth of beam is 230mm. (15 Marks)

**OR**

- 6 a. What is Torsion? Write expression for equivalence bending moment and equivalent shear force for members subjected to torsion. (04 Marks)
- b. Design a intermediate T – beam for a hall measuring  $6.5\text{m} \times 12\text{m}$  (clear dimension). Beams are spaced at 3m C/C. Depth of slab is 150mm. superimposed live load on slab is  $4.0\text{kN/m}^2$  finishes is  $1.0\text{kN/m}^2$ , Check for deflection also use  $M_{20}$  grade concrete and HYSD bar of Fe 500 grade. Sketch the reinforcement details. (16 Marks)

**Module-4**

- 7 Design an RC slab for a room measuring  $4\text{m} \times 5\text{m}$  inside. The slab carries a live load of  $2\text{kN/m}^2$  and is finished with 20mm topping of unit weight  $24\text{kN/m}^3$ . The slab is simply supported on all four edges with corners free to lift, No need to check for shear, Use  $M_{20}$  concrete and Fe 415 steel. (20 Marks)

**OR**

- 8 Design a dog legged stair for an office floor room measuring  $2.8\text{m} \times 5.8\text{m}$ , clear vertical distance between the floors is 3.6m. The width of height is to be 1.25 m. Assume imposed load of  $3\text{kN/m}^2$ . Use  $M_{20}$  concrete and Fe 415 grade steel. Assume that the stairs are supported on 230mm width support at the outer edges of landing slabs. Sketch the reinforcement detail. Design of one height is enough. (20 Marks)

**Module-5**

- 9 A corner column  $400 \times 400\text{mm}$  is subjected to a factored loads  $P_u = 1300\text{kN}$ ,  $M_{ux} = 190\text{kN/m}$  and  $M_{uy} = 110\text{kN/m}$ . Design the reinforcement in the column, assuming  $M_{25}$  concrete and Fe415 steel and effective cover of 60mm. Assume it as a short column. (20 Marks)

**OR**

- 10 Design a square footing for a short axially loaded column of size  $300\text{mm} \times 300\text{mm}$  carrying 600kN load. Use  $M_{20}$  concrete and Fe 415 steel. SBC of soil is  $180\text{kN/m}^2$ . Sketch the details of reinforcement. (20 Marks)

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