Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Design of RC structural Elements

Time: 3 hrs. Max. Marks: 100

Note: ***Answer FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define characteristic strength of materials and characteristic loads with sketches. **(04 Marks)**

b. Distinguish between : (i) Balanced section, (ii) Under –reinforced section and (iii) Over reinforced section with sketches. Which section is preferable and why? **(10 Marks)**

c. Derive an expression for $\bar{y}$, the depth of centre of compressive force from the extreme compressive fiber for a singly reinforced rectangular beam section. **(06 Marks)**

OR

2 a. What are the assumption made in the limit state of design for collapse in flexure in singly reinforced beam section. **(04 Marks)**

b. A simply supported beam has a rectangular section of size 300mm × 650mm and carries a uniformly distributed load of 15 kN/m over a clear span of 5.5 m. It is reinforced with 4 bars of 25 mm diameter bar. Use M25 concrete and Fe 500 grade HYSD bars. Compute short and long term deflections of the beam. **(16 Marks)**

Module-2

3 a. A reinforced concrete Cantilever beam 2 m long and having cross section of size 240mm × 400mm is reinforced with 4 bars of 16 mm diameter at top on tension side. The beam is designed to support a concentrated load of 3 kN at the free end in addition to uniformly distributed load on it. Determine the permissible uniformly distributed load, the beam can carry on it. Use M20 grade concrete and Fe 415 grade steel. **(10 Marks)**

b. A doubly reinforced beam section is 300 mm wide and 500 mm deep to the centre of tensile reinforcement. It is reinforced with compression reinforcement of 300 mm^2 at an effective cover of 50 mm and tension reinforcement of 1800 mm^2. Determine the safe moment of resistance of the section. M20 grade concrete and Fe 500 grade steel is used. **(10 Marks)**

OR

4 a. A singly reinforced concrete slab 150 mm thick is reinforced with 10 mm diameter bars at 200 mm centres located at an effective depth of 125 mm. M20 grade concrete and Fe415 grade HYSD bars are used. Estimate the ultimate moment of resistance of the section. **(04 Marks)**

b. A rectangular RC section of size 300 × 600mm effective is reinforced with 4 bars of 25 mm diameter HYSD bar of grade Fe 415. Two of the tension bars are bent at 45° near the support section. The beam is provided with double legged vertical links of 8 mm diameter at 150 mm centres near supports. Using M-25 grade concrete, compute the ultimate shear strength of the support section. **(08 Marks)**

c. A simply supported T-beam of depth of 450 mm has a flange width of 1000 mm and depth of 120 mm. It is reinforced with 6 – 20 mm diameter bars on tension side with a clear cover of 30 mm. M20 grade concrete and Fe415 grade steel are used. Calculate moment of resistance of beam. Take, $b_w = 300$ mm. **(08 Marks)**

Module-3

5 a. Design a singly reinforced beam simply supported at its two ends for flexural reinforcement. The clear span of beam is 5.6 m, the intensity of uniformly distributed superimposed dead and live loads are 18 kN/m and 26 kN/m. Use M-25 grade of concrete and HYSD steel of Fe500 grade. The beam should meet the durability requirement for exposed conditions of 'Severe' atmospheric and fire resistance of one and half hour. **(08 Marks)**

b. Design a doubly reinforced rectangular beam of size 300mm × 600mm simply supported at both ends. Check for deflection need not be calculated. The effective span is 5.6 m. The beam carries a service imposed load of 24 kN/m and super imposed dead load of 16 kN/m. Use M20 grade of concrete and HYSD steel of Fe415 grade. **(12 Marks)**

OR

6 Design an intermediate T-beam for a hall measuring 6.5m × 12m (clear dimensions). Beams are spaced at 3 m C/C. Depth of slab is 150 mm. Super imposed live load on slab is 4.0 kN/m^2, finishes is 1.0 kN/m^2. Check for deflection also. Use M20 grade concrete and HYSD bar of Fe500 grade. Sketch the reinforcement details. **(20 Marks)**

Module-4

7 Design a slab for a class room of dimension 4m × 6m (supported on all the four edges) with two adjacent edges discontinuous. Live load = 3 kN/m^2, Floor finish = 1 kN/m^2; Bearing = 300 mm. Use M20 grade concrete and Fe500 grade steel. Check for deflection need not be done. **(20 Marks)**

OR

8 Design the two flight dog legged stair for a hall of dimension (clear) 3m × 5m between the floors. The floor to floor height is 3.2 m and rise is 160 mm. Also check for deflection. Use M20 grade concrete and Fe500 grade steel. Sketch the reinforcement details of one flight. **(20 Marks)**

Module-5

9 a. Design the necessary reinforcement for RC column 450mm × 600mm to carry an axial load of 2000 kN. The length of the column is 3.5 m. Use M25 grade concrete and Fe415 grade steel. Sketch the reinforcement details. **(10 Marks)**

b. A rectangular column 300 mm wide and 500 mm deep is subjected to an axial factored load of 1200 kN and a factored moment of 200 kN-m. Calculate the necessary reinforcement distributing equally on all four sides. Sketch the reinforcement details. Adopt M25 and Fe500 grade materials. **(10 Marks)**

OR

10 Design a square footing of flat type for a column of size 400mm × 400mm to carry an axial dead load of 800 kN and a live load of 1000 kN without any moment. Safe bearing capacity of soil is 180 kN/m^2. Adopt M20 grade concrete and Fe 500 grade steel. Sketch the footing showing the details of reinforcement. **(20 Marks)**