22502

12223

4 Hours / 70 Marks Seat No. | | | | | | | | |

Instructions – (1) All Questions are *Compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) IS 456-2000 and IS-800-2007 codes not allowed during examination.

Marks

1. Attempt any FIVE of the following : **10**

a) Write the justification to the safety factor which is used in limit state design is referred as partial factor of safety.

b) State any loads to be considered while designing steel structures along with their respective IS codes.

c) State any two difference between simply supported slab and cantilever slab.

d) Give expression for development length alongwith the notations used in it.

e) Enlist any four functions of using transverse steel in the RCC column.

f) Define the characteristics load and design load.

g) Define the terms, end return and lap length used in welding connections along with their specifications as recommended by IS-800-2007.

Marks

2. Attempt any THREE of the following : **12**

a) State four benefits when steel is used as a construction material. Also, list any four steel structures along with their function.

b) Derive the neutral axis co-efficient and moment of resistance constant for a singly reinforced balanced section having effective depth 'd' and width 'b'. Use M20 concrete mix and Fe415 steel.

c) Diameter of steel is 20 mm, steel grade Fe415 and bond stress 1.2 MPa for plain bars in tension, calculate the development length for bars in compression.

d) A rectangular RC beam of effective section 230 mm wide and 400 deep is reinforced with 3 bars of 16 mm diameter. Determine the shear resistance of concrete section, if beam carries ultimate shear of 80 kN. Use M20 concrete of Fe415 steel. Take, permissible shear stress in concrete equal to 0.53 N/mm^2.

3. Attempt any TWO of the following : **12**

a) Determine the efficiency of Lap joint used to connect two plates of 10 mm thick. Use, Fe 410 grade for plate material and 4.6 grade for bolts. Take, the end distance equal to 30 mm and bolt diameter 20 mm with 50 mm pitch.

b) Define the under-reinforced over-reinforced and balanced sections used in RC design and also state which section is preferred and why. Draw a labelled sketch of stress block diagram for a singly reinforced RCC section by showing important parameters on it.

c) Calculate the lap of one plate having size 120 mm × 10 mm over the another plate of size 180 mm × 12 mm which transmits a pull equal to full strength of smaller plate. Assume, fillet weld of 6 mm size and welding is operated on three sides on the field. Use, yield stress as 250 MPa whereas ultimate stress equal to 410 MPa in steel.

Marks

4. Attempt any TWO of the following : **12**

a) A rectangular beam 250 mm wide and 550 mm deep with effective cover of 50 mm is used as simply supported beam of span 5 m. Calculate the central point load neglecting the self weight of beam can carry, if it is reinforced by 4-bars of 20 mm diameter. Use, M20 grade of concrete mix and Fe415 steel grade.

b) A RCC beam with 230 mm wide is used as a cantilever of span 4 m and carrying udl of 5 kN/m throughout the span. Design the singly reinforced beam using M20 concrete and Fe415 steel.

c) Calculate the spacing of 6 mm diameter mild steel of two legged vertical stirrups for a simply supported beam of span 3.6 m with 230 mm × 350 effective in cross-section. The beam is reinforced with 4-bars of 12 mm diameter on tension side and are continued into supports of grade Fe415. The beam is carrying total udl of 24 kN/m over entire span. Assume M20 concrete mix. Draw a cross-section showing reinforcement details. Use, table if necessary for shear strength of concrete mix (τ_c).

% Pt	0.25	0.50	0.75	1.00
τ_c in N/mm^2	0.36	0.48	0.56	0.62

5. Attempt any TWO of the following : **12**

a) Design a simply supported RC slab for a hall 3.8 m × 12 m clear dimension is supported on wall 230 mm wide all around. The slab is subjected to live load of 3 kN/m^2 along with finishing load of 1 kN/m^2. Use M20 concrete mix and Fe415 steel grade. No checks are allowed for the design and use modification factor equal to 1.4. Draw sketch of cross-section showing reinforcement details along shorter span only.

b) Calculate the reinforcement required for a RC slab panel of 6.3 m × 4.5 m is simply supported on all four sides. It has to carry the live load of 4 kN/m^2 including self weight of slab. Use M25 concrete and Fe415 steel. Sketch the cross-section of slab along longer span only showing reinforcement details. Use modification factor equal to 1.4 and bending moment coefficients are $\alpha_x = 0.085$ and $\alpha_y = 0.056$.

Marks

c) Design a cantilever slab 2 m × 3 m effective in plan dimensions is fixed along 3 m slab edge. It is loaded by superimposed load of 4 kN/m^2 including its own weight of slab. Use modification factor as 1.4 and take M20 concrete mix and Fe415 steel. Sketch the cross-section of slab showing reinforcement details. No checks are required during the design.

6. Attempt any TWO of the following : **12**

a) A square column of RCC is carrying working load of 1600 kN. The length of unsupported column is 3 m and is effectively held in position at both ends but restrained against rotation at one end only. Design the axially loaded short column using M25 and Fe415 as construction materials.

b) Determine the reinforcement for an isolated square footing with uniform depth is supported over soil strata having safe bearing capacity as 190 kN/m^2. The square column of 400 mm × 400 mm in section which transmits an axial load of 1000 kN through RC footing. Use M20 concrete mix and Fe415 steel grade. No checks for one way action and punching shear applied for footing depth calculation. Also, draw the cross-section of footing showing the reinforcement details.

c) i) Calculate the ultimate load carrying capacity of RC column having 400 mm × 400 mm in section. It is reinforced with longitudinal steel by 8-bars of 12 mm diameter. Use M20 concrete mix and Fe415 steel grade.

ii) Sketch the critical sections and their respective locations used as recommended by IS-456-2000 code while designing depth of pad footing for bending and shears only.