B.E. (civil) (VII) Limit state method for R.C.S.

Q.P.Code: 24199

[3hrs] [80 marks]

N. B. (1) Question No. **1** is **compulsory**.
(2) Solve any **three** questions from remaining questions.
(3) Assume suitable data wherever required and state them clearly.
(4) Use of IS 456 is not permitted.

1. (a) Justify the code provision for the limiting neutral axis depth for any section in LSM. 5
(b) Explain how the neutral axis is located in T beam section at the ultimate limit state, given that it lies outside the flange. 5
(c) The shear resistance of bent up bars cannot be counted upon, unless stirrups are also provided, Why? 5
(d) Why does the Code specify limits to the minimum and maximum reinforcement in columns? 5

3 (a) A rectangular R.C. beam is 300 mm x 600 mm deep. It is reinforced with 6 bars of 20 mm diameter on tension side and 3 bars of 16 mm diameter on compression side at an effective cover of 50 mm for both the steels. Calculate ultimate moment of resistance of the section if grade of concrete is M20 and grade of steel is Fe 415. 10

d' / d	0.05	0.1	0.15	0.2
f_{sc} (N/mm^2)	355.1	351.9	342.4	329.2

(b) A rectangular R.C beam is 300mm x 550 mm deep is subjected to an ultimate torsional moment of 40kNm, ultimate BM of 50kNm and ultimate shear force of 35kN. Adopt grade of concrete M 20 and grade of steel Fe 415. Assume effective cover to tension and compression reinforcement as 40mm.Design the beam. 10

p_t (%)	≤ 0.15	0.25	0.50	0.75	1.0	1.25	1.50	1.75	2.00
τ_c (N/mm^2)	0.28	0.36	0.48	0.56	0.62	0.67	0.72	0.75	0.79

2 (a) A singly reinforced rectangular beam with width 250 mm and effective depth 500 mm is reinforced with 5 bars of 20 mm diameter. Calculate the ultimate moment of resistance of the section using limit state method. Grade of concrete M 20 and steel Fe 415. 6
(b) A reinforced concrete beam 300 mm x 600 mm overall depth reinforced with 5 bars of 20 mm diameter is used as a simply supported beam over an effective span of 6 m. Determine the maximum udl the beam can carry safely (including self weight). Adopt M 20 grade of concrete and Fe 500 steel. 10

Turn Over

(c) What are the various factors that influence the effective flange width in a T beam? 4

4. (a) Design a slab on a hall of size 4 m x 6 m effective. The slab is simply supported on 230 mm wall on all four sides. Consider LL 3 kN/m^2 and floor finish 1 kN/m^2. Assume M 20 grade of concrete and Fe 415 steel. 12

Ly/Lx	1.1	1.2	1.3	1.4	1.5	1.75	2.0
α_x	0.074	0.084	0.093	0.099	0.104	0.113	0.118
α_y	0.061	0.059	0.055	0.051	0.046	0.037	0.029

Values of (k) for Solid Slabs.

Overall Slab Depth (mm)	≥ 300	275	250	225	200	175	≤150
(k)	1.00	1.05	1.10	1.15	1.20	1.25	1.30

b) Determine the ultimate moment of resistance of a T beam section using Fe 415 grade steel and M20 concrete grade. 8
Width of flange = 1000mm
Depth of slab = 100mm
Width of rib = 300mm
Area of steel = 6- 20 mm ϕ on tension side

5 (a) Draw Whitney's Stress block and hence determine the ultimate moment of resistance of a beam 300 mm wide and 600mm deep considering it as a balanced section. Take σ_{cu} = 20 N/mm^2 and σ_{sy} = 425 N/mm^2. 6

(b) A R.C. beam 250 mm x 500 mm effective depth is subjected to an ultimate moment of resistance of 250 kN-m. Calculate the steel reinforcement required for the beam. Assume σ_{cu} = 20 N/mm^2 and σ_{sy} = 425 N/mm^2. Use Ultimate Load Method. 10

(c) Explain the need for corner reinforcement in two way rectangular slabs whose corners are prevented from lifting up. 4

6 (a) A rectangular column of dimensions 300 mm x 650 mm is subjected to an ultimate axial load of 1500kN. Design an isolated footing for the column assuming safe bearing capacity of soil to be 250 kN/m^2. Adopt grade of concrete M 20 and grade of steel Fe 415. 12

(b) Design a short square column subjected to a factored load of 3000kN. Adopt grade of concrete M 25 and steel Fe 415. 8

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