

N.B.

1. Question no. 1 is compulsory. Attempt any THREE out of remaining FIVE questions.
2. Assume suitable data if necessary but justify the same.
3. Use of IS code is NOT permitted.

Q.1 Attempt any FOUR.

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- a. What is limit state? What are the various limit states in RCC? (5)
- b. State the assumptions made in the Limit State of Collapse (flexure) in RCC. Also draw strain and stress diagram across the section. (5)
- c. Draw the sketch of a sloped isolated footing and locate sections for B.M, S.F at one way and two way. (5)
- d. Write any four assumptions in Ultimate Load Design method in RCC. Also sketch the stress block used in this method. (5)
- e. What is strap footing? When it is provided? Also draw the sketch Of strap footing. (5)
- f. Derive stress block parameters in limit state method for collapse (flexure). (5)

Q.2 Attempt the following.

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- a. Determine the area of tension steel reinforcement for the beam having dimensions 300mm X 550 mm (effective), if it is subjected to a hogging bending moment of 120 kN.m. Also draw stress diagram across the section. (10)  
Use (i) M<sub>25</sub> concrete and Fe<sub>415</sub> steel. (ii) M<sub>20</sub> concrete and Fe<sub>250</sub> steel.
- b. A beam of size 300 x 550 mm overall, is subjected to a factored bending moment of 295 kNm. Compute the reinforcement required at an effective cover of 50 mm to compression and tension reinforcement. Use M 25 concrete and Fe 415 steel. (10)

d'/d	0.05	0.100	0.15	0.20
f <sub>sc</sub> (MPa)	355	353	342	329

Q.3 Attempt the following.

- a. A reinforced concrete beam of 300 x 550 mm overall is reinforced with 5 bars of 20 mm  $\phi$  HYSD steel of grade Fe 500, placed at an effective cover of 50 mm. The beam carries a factored UDL of 120 kN/m (working) over a simply supported clear span of 5 m. Design the shear reinforcement. Use M 20 concrete. Also sketch the shear reinforcement details. (20)

pt%	0.50	0.75	1.0	1.25	1.5	1.75
$\tau_c$ MPa	0.48	0.56	0.62	0.67	0.72	0.75

- b. A tee beam having 1250 mm effective width of flange has a thickness of flange equal to 110 mm. The effective depth of the beam is 600 mm and width of the web (10)

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is 300 mm. It is reinforced with 6 bars of 20 mm  $\phi$  on the tension side. Determine moment of resistance if M 25 concrete and Fe 415 steel is used. Use LSM.

Q.4 Attempt the following. 20

- a. Design a circular column of diameter 400 mm, subjected to a load of 1350 kN. The column is having spiral ties. The column has 2.9m effective length. Use M25 concrete and Fe 415 steel. Use LSM (8)
- b. A hall of a residential building measures 4.1 m x 5.8m. It is supported by 300 mm thick wall on all four sides. Design the simply supported slab using M 20 and HYSD Fe 415 steel. Assume the live load on the slab as  $3\text{kN/m}^2$  and the floor finish load as  $1\text{kN/m}^2$ . Apply checks for shear, deflection and development length. Sketch the reinforcement details along both spans. (12)

$L_y/L_x$	1.3	1.4	1.5	1.75
$\alpha_x$	0.093	0.099	0.104	0.113
$\alpha_y$	0.055	0.051	0.046	0.037

Q.5 Attempt the following. 20

- a. Write step by step procedure to design one way slab with all required checks. (4)
- b. A rectangular beam of size 300 x 450 mm overall is reinforced with 4 bars of 20 mm  $\phi$  as tension reinforcement. It is subjected to a shear force of 20 kN and a bending moment of 20 kN m. In addition to this it also carries a torsional moment of 2 kN m. Design the beam for combined BM, SF and TM. Assume 50 mm as effective cover to the tension and compression reinforcement. Use M20 and Fe415 as grades of the materials. (8)
- c. A RCC beam of size 260x 550 mm effective depth, is reinforced with 3 bars of 16mm dia. in tension zone. Determine moment of resistance using Ultimate load method in RCC. Use M25 and Fe 415 as the materials. Also Draw Stress block across the section. (8)

Q.6 Design the combined footing for two columns C1 of size 400x400 mm and C2 of size 500 x 500 mm in size and carrying 500 KN and 800 KN as working loads respectively. The columns are spaced at 4 m apart. The available width restriction is 2.4 m. The smaller column is 0.4 m away from the property line. The SBC of the soil is  $140\text{kN/m}^2$ . Use M 25 and Fe 415. Sketch reinforcement details. 20

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