Name: **Enrolment No:**	

UPES

End Semester Examination, May 2025

Course: Design of concrete structures **Semester: VI**

Program: B. Tech. Civil Engineering **Time: 03 hrs.**

Course Code: CIVL3062 **Max. Marks: 100**

Instructions:

- **Assume suitable values for any missing data.**
- **Unless otherwise specified, assume M20 grade of concrete and Fe415 grade of steel.**

SECTION A

(5Qx4M=20Marks)

S. No.		Marks	CO
Q1	Discuss the circumstances in which doubly reinforced beams are used.	**4**	**CO2**
Q2	(i) Differentiate between a short and a slender column. (ii) For a concrete grade of M25, calculate the short-term modulus of elasticity and modulus of rupture of concrete.	**2+2**	**CO2**
Q3	Enumerate the functions of a transverse reinforcement in a reinforced concrete column.	**4**	**CO2**
Q4	Derive the expression for maximum strain at the level of compression steel for a rectangular section having effective cover to compression steel as *d'* and neutral axis depth from compression face as x_u.	**4**	**CO1**
Q5	Explain under reinforced and over reinforced failure of a reinforced concrete beam.	**4**	**CO1**

SECTION B

(4Qx10M= 40 Marks)

Q6	Use limit state method to design a RC rectangular beam having an effective simply supported span of 6 m. The beam is required to support live service load and superimposed dead load of 14 kN/m and 9.5 kN/m respectively. The material to be used are M20 grade concrete and HYSD bars of grade Fe415. The unit weight of concrete is 25 kN/m^3. Adopt an effective depth-to-width ratio of 2. **OR** A singly reinforced rectangular concrete beam has a width of 150 mm and an effective depth of 330 mm. The characteristic compressive strength of concrete is 20 MPa and the characteristic tensile strength of steel is 415 MPa. Adopt stress block for concrete as given in IS456:2000. Determine the limiting value of moment of resistance and the limiting area of tension steel.	**10**	**CO3**

<table>
<tr><td>Q7</td><td>An RCC beam has 230 mm width and 500 mm overall depth. The effective cover to compression steel and tension steel is 40 mm. Compression reinforcement consists of 2 Nos. of 16 mm diameter bars and tension steel consists of 2 Nos. 25 mm diameter bars. This doubly reinforced beam is made of M25 concrete and Fe415 steel. Determine the moment of resistance of the beam. The stresses (MPa) in compression reinforcement are presented in the table below for different values of d'/d.
<table>
<tr><td rowspan="2">Fe415 grade of steel</td><td colspan="4">d'/d</td></tr>
<tr><td>0.05</td><td>0.10</td><td>0.15</td><td>0.20</td></tr>
<tr><td>Stress (MPa)</td><td>355</td><td>353</td><td>342</td><td>329</td></tr>
</table>
</td><td>10</td><td>CO3</td></tr>
<tr><td>Q8</td><td>A reinforced concrete column of effective length 3.0 m is to be designed to support a factored load of 2400 kN. Determine the cross-sectional dimension of the column and reinforcement when one side of column is restricted to 350 mm. Use M20 grade of concrete and Fe415 grade of steel.</td><td>10</td><td>CO4</td></tr>
<tr><td>Q9</td><td>A 5 m effective span simply supported beam is subjected to a load of 40 kN/m including its self-weight. The size of the beam is 250 mm x 500 mm. The beam is reinforced with 2 Nos. of 20 mm diameter bars at the bottom face of the critical section. Design the beam against shear. Use M20 grade of concrete and Fe415 grade of steel.</td><td>10</td><td>CO3</td></tr>
<tr><td colspan="4">SECTION-C
(2Qx20M=40 Marks)</td></tr>
<tr><td>Q10</td><td>Design a two-way slab for an office room 5.8 m x 4.2 m clear in size if the superimposed load is 4 kN/m^2. Assume the edges of the slab are simply supported and the corners are not held down. Use M25 grade of concrete and Fe415 grade of steel.
OR
A room 17.5 m x 10 m has brick walls all around and it is to be covered with reinforced concrete slab supported on the walls and on the central beams in the East-West and North-South direction along the middle of the room. The slab has to carry a live load of 4 kN/m^2. Assume mild exposure condition and that M20 concrete with Fe415 steel are used for construction. The slabs are restrained on top of the walls by the brick masonry built above it. Design the slab.</td><td>20</td><td>CO4</td></tr>
<tr><td>Q11</td><td>A RC column of size 460 mm x 600 mm having an effective length of 3.6 m is to support an axial service load of 2500 kN. Use M20 grade of concrete and Fe415 grade of steel. Design the column using limit state method and show complete detailing of the reinforcement for the column.</td><td>20</td><td>CO4</td></tr>
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