R09

Set No. 2

Time: 3 hours

Code No: R09220102

Max Marks: 75

Answer any FIVE Questions All Questions carry equal marks ****

- 1. A hollow steel column of square section of side 450 mm and the thickness of the section is 25 mm. The column carries an eccentric load P at an eccentricity of 'e'. If the extreme compressive stresses induced in the section are 25 N/mm^2 at one end and to 75 N/mm² at the other end. Determine the values of P and e. [15]
- 2. (a) Differentiate between close and open coiled helical springs.
 - (b) Derive, from fundamentals, the expression for the strain energy stored in a closed coiled helical spring subjected to an axial load. [7+8]
- 3. Determine the deflection at the mid span of a cantilever beam of span 3.0 m and subjected to the loading shown in figure 1. $\left[15\right]$



- 4. A 3.6 m long tubular steel strut is 65 mm external diameter and 50 mm internal diameter with both ends hinged. The strut is subjected to an eccentric load. Determine the maximum eccentricity for a crippling load of 0.75 times the Euler's value. Assume the yield stress of the material as 250 MPa. 15
- 5. A cantilever beam consists of 90 mm \times 60 mm \times 8 mm unequal angle section with the shorter leg horizontal. It carries a concentrated load of 5 kN at a distance of 1.0 m from the support and in a plane making 30^0 with respect to vertical. Determine the maximum stress at the support section and also find the neutral axis of the section. [15]
- 6. A curved beam semi-circular in plan, 5 m radius, and supported on three equally spaced supports. The beam carries a uniformly distributed load of 20 kN/m of the circular length. Analyse the beam and draw the twisting moment diagram. [15]
- 7. A steel fixed square tubular beam column of size, 50 mm \times 50 mm \times 4.5 mm is 2.7 m long. It is required to carry an axial load of 80 kN in addition to a lateral load of 12 kN at its mid-span. Determine the maximum bending moment. 15

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Code No: R09220102

R09

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8. A continuous beam of uniform cross-section supported and loaded as shown in figure 2. Draw the shear force and bending moment diagrams if the supports B and C sink by 25 mm and 10 mm respectively. [15]



R09

Set No. 4

Time: 3 hours

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Max Marks: 75

Answer any FIVE Questions All Questions carry equal marks ****

1. A continuous beam of prismatic cross-section supported and loaded as shown in figure 3. Draw the shear force and bending moment diagrams with salient features.



- 2. A steel hinged tubular beam column with external and internal diameters of 80 mm and 60 mm, respectively, is 1.2 m long. It is subjected to an axial force 20 kN and moment 1.2 kNm at each end causing single curvature. Determine the maximum bending moment. [15]
- 3. Design a hollow circular mild steel column, 5.7 m long, one end fixed and the other end hinged, to carry an axial load of 450 kN. Take the factor of safety as 3. The internal diameter is 0.65 times the external diameter. The Rankine's constants are 320 MPa and $\frac{1}{7500}$. [15]
- 4. Find the position and magnitude of the maximum deflection of a steel fixed beam loaded as shown in the Figure 4. Assume the second moment of inertia if the cross-section of the beam is $50 \times 10^6 mm^4$. [15]
- 5. A solid circular shaft is subjected to a bending moment of 300 kNm, a twisting moment of 125 kNm. If the yield stress of the shaft material is 350 N/mm^2 , determine the diameter of the shaft according to the maximum shearing stress theory of failure. $\left[15\right]$
- 6. A concrete block has the cross-section shown in figure 5. The block weighs 100 kN and carries a vertical compressive load of 25 kN at 'e' on XX axis but eccentric about YY axis. Calculate the eccentricity if the pressure under the block along the edge AB is half the pressure along the edge CD and determine the pressures. [15]



Figure 5:

Code No: R09220102

R09

Set No. 4

- 7. A 150 mm \times 150 mm \times 12 mm steel angle is used as a cantilever beam of length 1.5 m with one of the legs vertically down ward and carries a concentrated load at its free end in a vertical plane passing through centroid of the section. Determine the maximum load if the bending stress is limited to125 N/mm². Also find the maximum deflection. [15]
- 8. A uniform cross-section semi-circular beam of radius 3 m is simply supported by equally spaced three columns. The beam is subjected to two concentrated loads of magnitude 20 kN each and acting at the mid-span section of the segment of the beam joining the two supports. Draw the bending moment and twisting moment diagrams. [15]

R09

Set No. 1

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Answer any FIVE Questions All Questions carry equal marks *****

- 1. A shaft of 150 mm diameter, 2.5 m long is subjected to a torque of 15 kNm. Determine the maximum shear stress and the angle of twist. If the central 1.0 m length of the shaft was reduced to 100 mm diameter and if the same torque is applied, what would be the change in the shear stress and the angle of twist? Assume $G = 0.8 \times 10^5 N/mm^2$. [15]
- 2. A 100 mm \times 100 mm \times 12 mm equal angle section cantilever beam 1.2 m long with one of the legs vertically upward is subjected to a vertically downward concentrated force 8 kN at its free end. Determine the maximum stress at a section 0.75 m from the applied force. [15]
- 3. A reinforced concrete chimney shaft 30 m high tapers from 3 m external diameter at the base to 1.2 m external diameter at the top. The chimney has uniform thickness of 450 mm. If the horizontal wind pressure is 100 kg/m², find the distribution of the stress at the base. [15]
- 4. Find the Euler's erushing load for a hollow cylindrical steel column of length 6 m, 175 mm external diameter and 25 mm thick. The both ends of the column are fixed. Compare this load with the crushing load given by Rankine's formula. The Rankine's constants are 320 N/mm^2 and $\frac{1}{7500}$. For what length of this cross-section does the Euler formula ceases to apply? [15]
- 5. A continuous beam is supported and loaded as shown in figure 6. Draw the shear force and bending moment diagrams. [15]



Figure 6:

6. A steel fixed-fixed tubular beam column with external and internal diameters of 150 mm and 125 mm, respectively, is 3 m long. It is subjected to an axial force 60

Code No: R09220102

Set No. 1

kN and a downward transverse load 5 kN at its mid-span Determine the maximum bending moment. [15]

- 7. A uniform cross-section semi-circular beam of radius 3.5 m is simply supported by equally spaced three columns. The beam is subjected to two concentrated loads of magnitude 30 kN each and acting at the mid-span section of the segment of the beam joining the two supports. Draw the shear force and bending moment diagrams. [15]
- 8. Draw the shear force and bending moment diagrams of the propped cantilever beam loaded as shown in the Figure 7. [15]



R09

Set No. 3

Time: 3 hours

Code No: R09220102

Max Marks: 75

Answer any FIVE Questions All Questions carry equal marks ****

- A hollow circular steel strut with external diameter of 40 mm, internal diameter 30 mm, 1.8 m long carries a compressive load of 25 kN at an eccentricity of 20 mm. Determine the maximum stress induced in the section of the column. [15]
- A circular beam of radius 5 m and uniform cross-section is supported on six symmetrically placed columns. The beam is subjected to a uniformly distributed load of intensity 25 kN/m. Determine the position and magnitude of maximum torsional moment. [15]
- 3. A wooden beam of rectangular cross-section 150 mm \times 300 mm is used to support a uniformly distributed load of 10 kN (total) on a simply supported beam of span 3 m. The applied load acts in a plane making an angle 25⁰ with respect to vertical and passing through the centroid of the section. Determine the maximum bending stress at mid-span and also locate the neutral axis. [15]
- 4. Draw the shear force and bending moment diagrams of a fixed beam loaded as shown in the Figure 8. [15]



Figure 8:

- 5. A solid shaft of 200 mm diameter is subjected to a bending moment of 600 kNm, a twisting moment of 450 kNm and an end thrust of 225 kN. Determine the location and the magnitude of principal stresses and maximum shear stress induced. [15]
- 6. A continuous beam of uniform cross-section supported and loaded as shown in figure 9. Draw the shear force and bending moment diagrams. [15]
- 7. A steel hinged square tubular beam column of size, 60 mm × 60 mm × 4.8 mm is 2.5 m long. It is required to carry an axial load of 75 kN in addition to a transverse uniformly distributed load 2 kN/m length over its entire span. Determine the maximum stress. [15]



Figure 9:

8. A masonry dam of trapezoidal section is 7.5 m high, 1.25 m wide at top with its water-face vertical. Calculate the base width required to avoid tension at the base if water is stored up to the top of the dam. Assume the unit weight of masonry is 20 kN/m^3 . [15]

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