Code No: RR220102 **Set No.1**

II B.Tech. II Semester Regular Examinations, April/May -2005
STRENGTH OF MATERIALS-II
(Civil Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. A tie bar of cross - sectional area $1000mm^2$ is subjected to an axial tensile load of 70 kN. Find the normal, tangential and resultant stresses on a plane the normal to which makes an angle of 30^0 with the axis of the bar. Find also the max. values of these stresses and the planes on which they act.

2. Based on shear strain energy theory, suggest a safe dia. for a steel rod subjected to an axial pull of 9 kN and a transverse shear of 5 kN. Take the elastic limit as 240 MPa and factor of safety 3, Poisson's ratio = 0.3.

3. (a) What do you understand by pure torsion state the assumptions made in the theory of pure torsion.
   (b) With usual notation derive the torsion equation: $\frac{T}{J} = \frac{q}{r} = \frac{N\theta}{L}$

4. Two co-axial springs, one placed inside the other and made of steel wires of the same dia. support an axial compressive load P on a rigid plate on the top of the springs. The number of coils in the two springs are 10 and 12 while the mean radii of the coils are 40mm and 60mm. Both the springs are of equal length before loading. Calculate P, if the wire dia. is 8mm and the shear stress in the wire is not to exceed $800N/mm^2$.

5. An R.S.Tee-section, 150mm wide × 75mm deep, thickness of flange 9mm, thickness of web 8.4mm, is used as a strut, 3 metre 4 long, ends hinged.Calculate the safe axial load by Rankines formula, using a factor of safety of 3. Rankines constants, $fc = 315N/mm^2$; a = 1/ 7500.

6. (a) What do you understand by "Beam-columns"?
   (b) A horizontal strut of length L, having hinged ends, carries an axial compressive load P, and central vertical load W. Derive expression for max values of deflection, B.M. and stress.

7. The internal dia. of a thick spherical shell is 200mm and the wall thickness is 50mm. Calculate the max. and minimum values of circumferential stresses due to an internal pressure of $6N/mm^2$.

8. Find the max bending stress due to a B.M. of 2 KN-m acting on an R S J used as a simple beam, Whose properties are given below. Find also the plane of loading to give max bending stress. Solve by drawing Z- Polygon or an alyticelly.
   Width of flange=100mmdepth of section=200mm
   Thickeners of web=5.4mm Thickeners of flange=7.3mm

$Iuu = 1696.610^4 mm^4$ $Iuu = 115.410^4 mm^4$
$Zuu = 169.710^3 mm^3$ $Zuu = 23.110^3 mm^3$

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2. Using

   (a) max. shear strain energy theory and

   (b) max. strain theory find the magnitude of minor principal stress in a steel member,

   if at a point the major principal stress is $20N/mm^2$ (tensile) and the minor principal stress is compressive. Take Poisson's ratio = 1/3.

3. Explain the procedure of the design of circular shafts according to various theories of failure.

4. Two co-axial springs, one placed inside the other and made of steel wires of the same dia. support an axial compressive load P on a rigid plate on the top of the springs. The number of coils in the two springs are 10 and 12 while the mean radii of the coils are 40mm and 60mm. Both the springs are of equal length before loading. Calculate P, if the wire dia. is 8mm and the shear stress in the wire is not to exceed $800N/mm^2$.

5. An R.S.Tee-section, 150mm wide × 75mm deep, thickness of flange 9mm, thickness of web 8.4mm, is used as a strut, 3 metre 4 long, ends hinged.Calculate the safe axial load by Rankines formula, using a factor of safety of 3. Rankines constants, $fc = 315N/mm^2$; a = 1/ 7500.

6. A horizontal strut 3m long is of-hollow circular section 16cm external dia. And internal dia. 14cm. It carries an end thrust of 300kN along with a u.d.l of 5kN/m. Assuming the ends as hinged and taking the self weight also into account, calculate the max. stress induced in the section ($Density = 78.5kN/m^3$).

7. Compare the values of max. and minimum hoop stresses for a cast steel cylindrical shell of 600 mm external dia. And 400 mm internal dia. Subjected to a pressure of $30N/mm^2$ applied

   (a) Internally and

   (b) Externally.

8. An unequal angle $60 \times 40 \times 6mm$ is placed with the longer leg vertical and is used as a beam. It is subjected to a B.M. of 10KN-M acting in the vertical plane through the c.g. of the section. Locate the neutral axis of the section. Determine the max. Bending stress induced in the section. Verify the value by an alternate Solution.

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1. At a point in a bracket the tensile stresses on two mutually perpendicular planes are 55 MPa and 25 MPa. The magnitude of shear stress across these planes is 15 MPa. Using Mohr's circle of stress, find the normal, tangential and resultant stresses on a plane making an angle of 25^o with the plane of first stress.

2. Using

   (a) max. shear strain energy theory and

   (b) max. strain theory find the magnitude of minor principal stress in a steel member,

   if at a point the major principal stress is $20N/mm^2$ (tensile) and the minor principal stress is compressive. Take Poisson's ratio = 1/3.

3. A solid shaft, 80mm in dia. transmits 120 H.P. running at 180 R.P.M. Calculate the max. intensity of shear stress induced and the angle of twist for a length of 6m. Take $N = 8X10^4N/mm^2$.

4. Derive the deflection formula for an open coiled helical spring subjected to an axial load.

5. An R.S.Tee-section, 150mm wide × 75mm deep, thickness of flange 9mm, thickness of web 8.4mm, is used as a strut, 3 metre 4 long, ends hinged.Calculate the safe axial load by Rankines formula, using a factor of safety of 3. Rankines constants, $fc = 315N/mm^2$; a = 1/ 7500.

6. A cylindrical chimney shaft of a hollow circular section, 2.50 metres external diameter, 1 metre internal diameter, is 30 metres high. If the horizontal intensity of wind pressure varies as $X^{2/3}$ where X is the vertical height above the ground, calculate the overturning moment at the base due to the force of wind pressure, taking the coefficient of wind-resistance as 0.6. Given that the horizontal intensity of wind pressure at a height of 20 metres is $1KN/m^2$. If the weight of masonry is $22.5KN/m^3$, calculate the extreme intensities of stress at the base.

7. A thick cylinder having internal radius 200mm and external radius 300mm is subjected to $4N/mm^2$. Find the internal pressure that can be applied if the max. permissible stress is $15N/mm^2$. Find also the change in thickness of the cylinder. Take $E = 200GN/m^2$ and $\frac{1}{m} = 0.3$

8. Draw the Z-polygon for a $160mm \times 60mm$ channel section, thickness of flanges 10 mm, thickness of web 7.5 mm, and locate position of the plane of loading for minimum strength. Hence, calculate the minimum bending moment to induce a maximum bending stress of $150N/mm^2$, the section.

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1. A piece a elastic material is subjected to 3 mutually perpendicular tensile stresses. The strains in the three direction are in the ratio of 3:4:5. Find the magnitude of there stresses if the greatest stress is 65 MPa. Take Poisson's ratio as 1/3.

2. Applying max. strain energy theory find the dia of a steel bar subjected to an axial pull of 10 kN along with a transverse S.F of 5 kN. Take the elastic limit in tension as 240 MPa and F.O.S. = 3.

3. (a) Explain the terms torsional rigidity, torsional section modulus and polar moment of inertia.
   (b) Derive an expression for the power transmitted by a circular shaft in
      i. kW
      ii. H.P.

4. A railway wagon having a mass of 5500 kg and moving with a speed of 10 km.ph. has to be stopped by 4 buffer springs in which the max compressions allowed is 20mm. Find the number of turns in each spring if the dia. of wire is 30mm and mean dia. of coil is 150mm. Take $N = 8X104N/mm^2$.

5. An R.S.Tee-section, 150mm wide × 75mm deep, thickness of flange 9mm, thickness of web 8.4mm, is used as a strut, 3 metre 4 long, ends hinged.Calculate the safe axial load by Rankines formula, using a factor of safety of 3. Rankines constants, $fc = 315N/mm^2$; a = 1/ 7500.

6. (a) What do you understand by "Beam-columns"?
   (b) A horizontal strut of length L, having hinged ends, carries an axial compressive load P, and central vertical load W. Derive expression for max values of deflection, B.M. and stress.

7. A thick-walled cylinder 160 mm internal diameter is to contain fluid at a pressure of $52.5N/mm^2$. Find the necessary thickness if the maximum shearing stress is not to exceed $90N/mm^2$. What will then be the maximum and minimum values of the hoop stress in the material? If the inner surface becomes corroded and the cylinder has to be re-bored, by how much can the inside diameter be increased without raising by more than 5% the maximum shearing stress induced by the same internal pressure?

8. What is Z- Polygon and how is it useful? Obtain the Z- Polygon for a rectangular section and sketch the same.

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