Code: 9A01401

1

B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

STRENGTH OF MATERIALS - II

(Civil Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions

All questions carry equal marks

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1 A closed cylindrical vessel made of steel plates 5 mm thick with plane ends, carries fluid under pressure of 6 N/mm^2.The diameter of the cylinder is 35 cm and length is 85 cm. Calculate the longitudinal and hoop stresses in the cylinder wall and determine the change in diameter, length and Volume of the cylinder. Take E = $2.1x10^5$ N/mm^2 and 1/m = 0.286.

2 (a) What are the different methods of reducing hoop stresses? Explain the terms: Wire winding of thin cylinders and shrinkage one cylinder over another cylinder.

(b) Derive Lame's equations.

3 A hollow steel shaft of external diameter equal to twice the internal diameter has to transmit 2250 KW power at 400 r.p.m. If the angle of twist has not to exceed 1^0 in a length equivalent to 10 times the external diameter and the maximum turning moment is 1/4 times the mean, calculate the maximum stress and diameter of the shaft. Assume the modulus of rigidity to be 0.8×10^5 N/mm^2.

4 A helical spring, in which the mean diameter of the coils is 8 times the wire diameter, is to be designed to absorb 200 N-m of energy with an extension of 10 cm. The maximum shear stress is not to exceed 125 MPa. Determine the mean diameter of the helix, diameter of the wire and the number of turns. Also find the load with which an extension of 4 cm could be produced in the spring. G = 84 Gpa.

5 (a) Derive the Euler's buckling load for a column with both ends hinged.

(b) Find the ratio of buckling strength of a solid column to that of a hollow column of the same material and having the same cross-sectional area. The internal diameter of the hollow column is half of its external diameter. Both the columns are hinged and the same length.

6 A hollow rectangular masonry pier is 120 cm × 80 cm wide and 15 cm thick. A vertical load of 200 kN is transmitted in the vertical plane bisecting 120 cm side and at an eccentricity of 10 cm from the geometric axis of the section. Calculate the maximum and minimum stress intensities in the section.

7 A cantilever of rectangular section 40 mm (width) × 60 mm (depth) is subjected to an inclined load P at the free end. The inclination of the load is 25^0 to the vertical. If the length of the cantilever is 2 meters and maximum stress due to bending is not to exceed 200 MN/m^2, determine the value of P.

8 Find the bending moment at mid span of the semicircular beam of diameter 6 m loaded at the mid span with a concentrated load of 80 kN. The beam is fixed at both supports. Find the maximum bending moment and maximum torque in the beam.

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STRENGTH OF MATERIALS - II

(Civil Engineering)

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1 A thin spherical shell, 1200 mm in diameter, is subjected to an internal pressure of 1.8 N/mm^2. Find the thickness of plate required if the permissible tensile stress is 120 N/mm^2. The joint efficiency may be taken as 75%.

2 A thick walled cylindrical pressure vessel has inner radius of 150 mm and outer radius of 185 mm. Draw a sketch showing the radial pressure and hoop stress distribution in the section of the cylinder wall, when an internal pressure of 10 MN/m^2 is applied.

3 A solid shaft of 250 mm diameter has the same cross-sectional area as the hollow shaft of the same material with inside diameter of 200 mm.

(a) Find the ratio of power transmitted by the two shafts for the same angular velocity, and

(b) Compare the angles of twist in equal lengths of these shafts, when stressed to the same intensity.

4 A laminated steel spring simply supported at ends with span of 0.75 m is centrally loaded with a load of 10 kN. The central deflection under the above load is not to exceed 50 mm and the maximum stress is to be 400 MPa, determine; (i) width of plate (ii) thickness of plate (iii) number of plates (iv) the radius to which plates should be bent so that the spring become straight under the given 7.5 kN load. Assume width = 12 x thickness and E = 200 GPa.

5 Derive a formula for the maximum compressive stress induced in an initially straight, slender, uniform strut when loaded along an axis having an eccentricity e at both ends which are pin-jointed.

6 A 10 m high brick masonry wall of rectangular section 4 m x 1.5 m is subjected to horizontal wind pressure of 15 N/mm^2 on the 4 m side. Find the maximum and minimum stress intensities induced in the base. Weight density of masonry = 22 kN/mm^2.

7 A 45 mm × 45 mm × 5 mm angle is used as a simply supported beam over a span of 2.4 meters. It carries a load of 300 N along the vertical axis passing through the centroid of the section. Determine the resulting bending stresses on the outer corners of the section, along the middle section of the beam.

8 A horizontal circular bow girder of radius 5 m is continuous over five equally spaced supports. It carries a vertical u.d.l of 50 kN/m. Obtain the B.M torsional moment and S.F diagrams for one span indicating the critical values.

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3

B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

STRENGTH OF MATERIALS - II

(Civil Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions

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1 A cast iron cylinder of 200 mm inner diameter and 12.5 mm thick is closely wound with a layer of 4 mm diameter steel wire under a tensile stress of 55 MN/m^2. Determine the stresses set up in the cylinder and steel wire if water under a pressure of 3 MN/m^2 is admitted in the cylinder. Take $E_{cast\ iron}$ = 100 GN/m^2, E_{steel} = 200 GN/M^2 and Poisson's ratio = 0.25.

2 (a) Stating assumptions derive Lame's equations to find out the stresses in a thick cylindrical shell.

(b) A hollow cylinder has an external diameter of 250 mm and thickness of the wall is 50 mm. The cylinder is subjected to an internal fluid pressure = 35 MPa and external pressure = 3.5 MPa. Calculate the maximum and minimum circumferential stresses and plot the variation of the same across the wall thickness.

3 A hollow steel shaft of external diameter equal to twice the internal diameter, 5 m long is to transmit 160 KW of power at 120 r.p.m. The total angle of twist is not to exceed 2^0 in this length and the allowable shear stress is 50 N/mm^2. Calculate diameter of the shaft.

4 A close-coiled helical spring is required to have an axial stiffness of 5 kN/m and an angular stiffness of 0.1 Nm per degree angle of twist. If the spring is made of steel wire 6 mm diameter, find the mean diameter of the coil and the number of turns required. Assuming E = 200 GPa and G = 80 GPa.

5 (a) Derive an expression for crippling load when one end of the column is fixed and the other end is free.

(b) Calculated the Euler's critical load for a strut of T-section. The flange width being 10 cm, overall depth 8 cm and both flange and stem 1 cm thick, the strut is 3 m long and is built in at both ends. Take E = 2 x 10 N/mm^3.

6 A masonry retaining wall, 7 meters high, is trapezoidal in section, 1 meter wide at the top and 3 meters at the base, with one side vertical. If the lateral pressure exerted by the retained material on the vertical face varies from zero at the top to 25 kN/m^2 at the base, calculate the maximum and minimum stresses induced in the base, the weight of masonry being 21 kN/m^3.

7 Find the centroidal principal moments of inertia of a equal angle section 30 × 30 × 8 mm.

8 Find the bending moment at mid span of the semicircular beam of diameter 9 m loaded at the mid span with a concentrated load of 60 kN. The beam is fixed at both supports. Find the maximum bending moment and maximum torque in the beam.

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4

B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

STRENGTH OF MATERIALS - II

(Civil Engineering)

Time: 3 hours Max Marks: 70

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1 A steel cylinder is 1 m inside diameter and is to be designed for an internal pressure of 8 MN/m^2. Calculate the thickness if the maximum shearing stress is not to exceed 35 MN/m^2. Calculate the increase in volume, due to working pressure, if the cylinder is 6 m long with closed ends. E = 200 GN/m^2, Poisson's ratio = 1/3.

2 A compound cylinder formed by shirking one tube to another in subjected to an internal pressure of 90 N/mm^2. Before the fluid in admitted, the internal and external diameters of the compound cylinder are 180 mm and 300 mm respectively and the diameter at the junction is 240 mm. If after shrinking on, the radial pressure at the common surface is 12 N/mm^2. Determine the final stresses developed in the compound cylinder.

3 Solid shaft is subjected to a torque of 100 Nm. Find the necessary shaft diameter if the allowable shear stress is 100 MPa and the allowable twist is 3 degree per 10 m length of the shaft. Take C = 1×10^5 N/mm^2.

4 A closed coiled helical spring made of round steel wire is required to carry a load of 800 N for a maximum stress not to exceed 200 N/mm^2. Determine the wire diameter if the stiffness of the spring is 10 N/mm and the diameter of the helix is 80 mm. Calculate also the number of turns required in the spring given G_{steel} = 80 kN/mm^2.

5 A stanchion is built-up of two 325 mm × 165 mm R.S. joists placed 200 mm centre to centre with two 400 mm × 12 mm plates riveted to each flange. If it is 6 meters long, both ends fixed, calculate the safe axial load using Rankine's formula and a factor of safety 3. For each joist, area of section = 54.9 cm^2; I_{xx} = 9874.6 cm^4; I_{yy} = 510.8 cm^4. Take f_c = 315 N/mm^2.

6 (a) What is the limit of eccentricity? Explain briefly.

(b) Explain core of section. Find out the core of a circular section?

7 A timber beam 250 mm wide by 300 mm deep is used as simply supported beam on a spam of 5 m. It is subjected to a concentrated load of 30 N at the mid-section of the span. If the plane of the load makers an angle of 45^0 with the vertical plane of symmetry find the direction of neutral axis and the maximum stress in the beam.

8 A curved beam, semi circular in plan of radius 5 m, supported on three equally spaced supports. The beam carries a uniformly distributed load of 30 kN/m of the circular length. Analyze the beam and sketch the bending moment and twisting moment diagrams giving the salient values.

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