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Code: 9A01401

II B. Tech II Semester (R09) Regular & Supplementary Examinations, April/May 2012

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) Derive the expression for circumferential and longitudinal stresses in case of thin cylindrical shell subjected to internal pressure.

(b) A cylindrical shell 3m long which is closed at the ends has an internal diameter of 1 m and a wall thickness of 15 mm. Calculate the circumferential and longitudinal stresses induced and also change in the dimensions of the shell if it is subjected to an internal pressure of 1.5 MN/M^2.

2 A cast iron pipe has 20 cm internal diameter and 50 mm metal thickness and carries water under a pressure of 5 N/mm^2. Calculate the maximum and minimum intensities of circumferential stress and sketch the distribution of circumferential stress intensity and intensity of radial pressure across the section

3 (a) Find an expression for the torque transmitted by a hollow circular shaft of external diameter=D_0 and internal diameter = D_i.

(b) A solid shaft of aluminum of length 2 m and of 75 mm diameter is to be replaced by a tubular steel shaft of the same length and the same outside diameter, such that each of two shafts have the same angle of twist per unit torsional moment over the total length. Determine the inner diameter of the tubular steel shaft, if the modulus of rigidity of steel is three times that of aluminum.

4 A close coiled helical spring made of round steel wire 6mm diameter, having 10 complete turns is subjected to an axial moment M. Determine the magnitude of the axial couple M if the maximum bending stress in a spring wire is not to exceed 240 N/mm^2. Calculate also the angle through which one end of the spring is turned relative to the other end, if the mean coil radius is 3 cm E_{steel} = 200 KN/mm^2.

5 Determine the section of a cast iron hollow cylindrical column 5 m long with ends firmly built in if it carries an axial load of 300 kN. The ratio of internal to external diameter is ¾. Use factor of safety of 8. Take f_c = 567 N/mm^2 and Rankine's constant $\alpha = 1 / 1600$.

6 (a) A masonry chimney 24 m high of uniform circular cross section. 3.5 m external diameter and 2 m internal diameter is subject to horizontal wind pressure of 1 KN/m^2 of projected area. Find the maximum and minimum stress intensities at the base if the specific weight of masonry is 22 KN/m^2.

(b) Determine the stress at all corners of a rectangular cross section 1200 mm X 800 mm due to a 100 KN compressive load acting at an eccentricity of 60 mm with respect to both centroidal axes of the cross section in the first quadrant.

7 Determine the principal moments of inertia for an unequal angle section
125 mm x 75 mm x 10 mm.

8 In a circular beam supported on 6 columns carrying a uniformly distributed load, determine the position and magnitude of maximum torsional moment and bending moment.

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2

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1 A cylindrical vessel with hemi-spherical ends is 1.2 meters long on its cylindrical portion and 0.6 meter diameter. Thickness of wall on the cylindrical portion is 7 mm. Taking internal pressure as 1 MPa, determine (a) Thickness of wall of hemispherical portion based on the condition that the circumferential strain in the cylindrical and spherical portions at the junction are equal and (b) change in volume of vessel. Take E=210 GPa and ν=0.3.

2 (a) Derive Lame's equations.
(b) In a thick cylinder with internal pressure of 6 Mpa, the circumferential stress at the outside surface is 20 Mpa. Calculate the circumferential stress at the inside surface and at point where the radial stress is 3 Mpa. Find out the longitudinal stress if the cylinder is closed at the ends and the inside diameter is 200 mm.

3 A solid shaft of 80 mm diameter is transmitting 100 kW power at 200 r.p.m. Calculate the maximum shear stress induced in the shaft and the angle of twist in degrees for a length of 6 m. Take N = 8 X 10^4 N/mm^2.

4 Find the mean radius of an open-coiled spring with an angle of helix of 30^0 to give a vertical displacement of 2.25 cm and an angular rotation of the loaded end of 0.02 radians under an axial load of 40 N. The material available is steed rod of 6mm diameter. E = 210 Gpa, G = 84 GPa.

5 A hollow cast iron column 200 mm outside diameter and 150 mm inside diameter, 8 m long has both the ends fixed. It is subjected to an axial compressive load. Taking a factor of safety as 6. Determine the safe Rankine's buckling load. Take f_c = 560 N/mm^2 and Rankine's constant α = 1 / 1600.

6 A short hollow cylindrical C.I. column is 240 mm external and 180 mm internal diameter. In casting, the bore got eccentric so that the thickness varies from 20 mm at one end to 40 mm at the other. If the column carries a load of 600 kN along the axis of the bore, calculate the extreme stresses induced in the section.

7 An ISMB 300 mm x 140 mm R.S. beam carries at a certain section, a bending moment M, the trace OY' of the plane of loading being inclined at 15^o to the YY axis . If I_{xx} = 8603.6 cm^4 and Iyy = 453.9 cm^4 evaluate M if the maximum bending stress induced in the section is 120 N/mm^2.

8 A semi circular beam is simply supported on three equally spaced columns. Shoe that the maximum bending moment and twisting moment s are equal to 0.425 Rr^2 and 0.1045 wR^2 respectively, where w is u.d.l. on the beam.

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3

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STRENGTH OF MATERIALS - II

(Civil Engineering)

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1 (a) Show that a thin walled spherical vessel of diameter d and thickness t is subjected to an internal pressure p, the increase in volume is equal to $\Pi\ pd^4 / 8\ t\ E\ (1-\nu)$.
(b) Derive the expression for circumferential and longitudinal stresses in case of thin cylindrical shell subjected to internal pressure.

2 A thick-walled steel cylinder has internal radius of 5 cm and external radius of 8 cm. This is subjected to an internal pressure of 250 MPa. The maximum hoop stress is not to exceed 280 MPa. If a cylindrical jacket of the same material is shrunk on the thick-walled cylinder in order to prevent the stress from exceeding 280 MPa. What should be the initial difference between the inner diameter of the jacket and the external diameter of the cylinder? Take E = 200 GPa, $\mu = 0.3$.

3 A shaft transmits 300 kW power at 120 r.p.m. Determine: (a) the necessary diameter of solid circular shaft (b) the necessary diameter of hollow circular section, the inside diameter being 2/3 of the external diameter. The allowable shear stress is 70 N/mm^2. Taking the density of material is 77 kN/m^3, calculate the % saving in the material if hollow shaft is used.

4 A spiral spring made of 6 mm diameter wire has 20 close coils, each 75 mm mean diameter. Find the axial load the spring will carry if the stress is not to exceed 180 N/mm^2. Also determine the extension of the spring and the work done per unit volume of the spring. Take G = 0.8 X 10^5 N/mm^2.

5 (a) Derive from fundamentals, the expression for Euler's crippling load for a strut fixed at one end and pin jointed at the other.
(b) A cylindrical column 150 mm external diameter, 100 mm internal diameter and 7 m long are hinged at both ends. Calculate the (i) Euler's crippling load (ii) crippling load as given by Rankine's formula. E = 80 GPa, σ_c = 550 MPa and Rankine's constant α = 1 / 1600. Also determine the length for which the two formulae would give the same crippling loads.

6 A masonry wall, 2.4 meters long, trapezoidal in section with one side vertical, is 6 meters high, 1.2 meters wide at the top and 3.6 meters at the bottom. A thrust of 173.2 kN is transmitted at the top, on the vertical side, in the middle of the length, at an angle of 30^0 to the horizontal. If masonry weighs 21 kN/m^3, calculate the extreme stresses on the base

7 A 125 mm x 75 mm x 10 mm unequal angle bar is placed with the longer leg vertical and used as a joist freely supported at the ends. It is subjected to a bending moment of 3000 Nm acting in the vertical plane through the centroid of the section. Find the maximum bending stress induced in the section.

8 Find the bending moment at mid span of the semicircular beam of diameter 8m 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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(Civil Engineering)

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1 A closed cylindrical vessel made of steel plates 4 mm thick with plane ends, carries fluid under pressure of 3 N/mm^2. The diameter of the cylinder is 25 cm and length is 75 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 Derive a formula for the difference of radii for shrinkage of a compound thick cylindrical shell.

3 A solid shaft of aluminum of length 1.5 m and of 60 mm diameter is to be replaced by a tubular steel shaft of the same length and the same outside diameter, such that each of two shafts has the same angle of twist per unit torsional moment over the total length. Determine the inner diameter of the tubular steel shaft, if the modulus of rigidity of steel is three times that of aluminum.

4 A safety valve of 75 mm diameter is to blow off at a pressure of 1 N/mm^2 by gauge. It is held by a close-coiled compression spring of circular steel bar. The mean diameter of the coil is 150 mm and the initial compression is 25 mm. find the diameter of the steel bar and the number of convolutions necessary if the shear stress allowed is 120 N/mm^2. Take G = 0.8 X 10^5 N/mm^2.

5 (a) Derive secant formula for columns under eccentric loading.
(b) A steel column is made of a 4m long channel section; 300 mm X 100 mm is fixed at both the ends. The thickness of flange is 11.6 mm while thickness of web is 6.8 mm. Using Rankine's Formula. Calculate the load it can carry with a factor of safety of 3. Take f_c = 330 N/mm^2 and Rankine's constant a = 1 / 7500.

6 A tapering chimney of circular section 45 m high, 3.6 m external diameter at the base and 2.4 meters external diameter at the top is subjected to a uniform wind pressure of 1.0 kN/m^2 of projected area. Calculate the overturning moment at the base. If the weight of the chimney is 6000 kN and the internal diameter at the base is 1.2 meters, calculate the maximum and minimum stresses induced in the base section.

7 Find the principal moment of inertia of angle section 60 mm x 40 mm x 6 mm.

8 A curved beam, semi circular in plan, supported on three equally spaced supports. The beam carries a uniformly distributed load of w/ unit of the circular length. Analyze the beam and sketch the bending moment, twisting moment diagrams and shear force diagram.

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