(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4044   Roll No. [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

B.Tech.

FOURTH SEMESTER EXAMINATION, 2004-2005

ADVANCE STRENGTH OF MATERIAL

Time : 2 Hours   Total Marks : 50

Note :   (i)   Answer **ALL** the questions.

        (ii)   Missing data, if any, may be suitably assumed.

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1.   Answer *any two* of the following :   (6x2=12)

    (a)   Derive the equation of equilibrium in "z" direction, by considering the equilibrium of an infinite-simally small rectangular element of size dx dy dz, in the cartesian co-ordinate system as,

$$\frac{\partial \sigma_{zz}}{\partial z} + \frac{\partial \tau_{xz}}{\partial x} + \frac{\partial \tau_{yz}}{\partial y} + \bar{z} = 0$$

Hence or otherwise prove that

$\tau_{xy} = \tau_{yx}$, etc.

    (b)   A fixed beam AB of span L carries a uniformly distributed load of ω per unit length and is propped at a distance L/3 from A. If the deflection of the beam at this point is KR, where R = load on the prop, determine the magnitude of R.

(c)   Write brief notes on any two of the following :

    (i)   Castigliano's theorem.

    (ii)   Conditions for statical indeterminacy

    (iii)   St. Venant's Principle

2.   Answer *any two* of the following :   (6x2=12)

(a)   A curved beam of rectangular section 6 cm deep and 4 cm wide is subjected to a bending moment of 1200 Nm which tries to straighten the beam. Find the bending stress, if mean radius of the beam is 6 cm.

(b)   A ring made of 20 mm diameter bar carries a pull of 4500 N. The mean diameter of the ring is 16 cm. Find the maximum tensile and compressive stresses in the ring.

(c)   A chain link is made of a bar of 10 mm diameter. The mean radius of ends of chain link is 30 mm while the length of each straight portion is 50 mm. A load of 1 kN is applied on chain hook in the direction parallel to straight portions. Determine the maximum stress in chain.

3.   Answer *any two* of the following :   (6½x2=13)

(a)   A channel section has overall depth of 250 mm, flange width of 125 mm, flange thickness of 20 mm and web thickness of 20 mm. Find the approximate location of shear centre.

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(b) A solid rotor of constant strength has thickness of 18 cm at the central axis. Find thickness at a radius of 20 cm from the axis if the rotor rotates at 3000 rev/min and the allowable tensile stress is 120 MN/m^2. Take density of the material of shaft $\varrho = 7500$ kg/m^3.

(c) Write short notes on any two of the following :
   (i) Unsymmetrical bending
   (ii) Rotating cylinder
   (iii) Shear centre

4. Answer *any two* of the following :   (6½x2=13)

(a) The modulus of rigidity of the material of a close coiled helical spring is 8.75×10^6N/cm^2. The mean coil diameter of the spring is 64 mm having 10 turns. If the diameter of the wire is 6.4 mm, find out the extension of the spring under a pull of 700 N. Take modulus of rigidity, $G = 8.4 \times 10^6$N/cm^2.

(b) A laminated spring is to carry a central load of 1 kN. The spring is 90 cm long and the width and thickness of each plate are respectively 8 cm and 1.2 cm. The bending stress in the plate material is 10 kN/cm^2. Determine the number of plates in the spring and initial deflection of the top spring $E = 2 \times 10^4$ kN/cm^2.

(c) A symmetric I-section has flanges of size 180 mm × 10 mm, web thickness 10 mm and overall depth 400 mm. What would have been the error in assessing torsional rigidity if the warping is neglected ?

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