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No. of Printed Pages—4 **ME–405**

B. TECH.

FOURTH SEMESTER EXAMINATION, 2003-2004

ADVANCED STRENGTH OF MATERIALS

Time : 2 Hours *Total Marks : 50*

Note : (1) Attempt **ALL** the questions.
(2) Missing data, if any, may be assumed suitably.

1. Answer any *TWO* of the following :— **(6×2=12)**

(a) At a point in a stressed material, the Cartesian stress components are :

$$\sigma_x = -40\,\text{MPa}, \quad \sigma_y = 80\,\text{MPa}, \quad \sigma_z = 120\,\text{MPa}$$

$$\tau_{xy} = 72\,\text{MPa}, \quad \tau_{yz} = 46\,\text{MPa}, \quad \tau_{zx} = 0.$$

Calculate the normal, shear and resultant stresses on a plane whose normal makes an angle of 48° with the x-axis and 61° with y-axis.

(b) Find out the fixing moments, support reactions and maximum deflection of a fixed beam carrying a central point load.

(c) Write brief notes on any *Two* of the following :—

(i) Three Moments Method

(ii) Compatibility Equations

(iii) Application of Castigliano's Theorem

2. Answer any *TWO* of the following :— **(6×2=12)**

(a) A bar of rectangular section b wide and d deep is curved to a mean radius of R.

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Bending moment M is applied to ends tending to increase the radius of curvature. Find the position of neutral axis from the centroidal axis and stress in bar at distance y from the neutral axis.

(b) A curved beam, rectangular in cross-section, is subjected to pure bending moment of + 400 N-m. The beam has width of 20 mm, and depth of 40 mm and is curved in plane parallel to the depth. The mean radius of curvature is 50 mm. Find the position of Neutral axis and also the ratio of maximum to minimum stress.

(c) A curved beam is formed of a tube 80 mm outside diameter and 5 mm thickness. The centre line of this beam is a circular arc of radius 150 mm. Determine the greatest tensile and compressive stresses set up by a bending moment of 2 kN-m tending to increase its curvature.

3. Answer any *TWO* of the following :— **(6·5×2=13)**

(a) A disc 30 cm diameter has a central hole of 5 cm diameter and runs at 8000 rev/min. Calculate the maximum values of circumferential, radial and shear stresses in the disc.

Take $\rho = 7500\,\text{kg/m}^3$ and $\mu = 0{\cdot}25$.

(b) A simply supported beam of T-section, 2·5 m long carries a central concentrated load inclined at 30° to y-axis as shown in fig.1. If the maximum compressive and tensile stresses in bending are not to exceed 7500 N/cm^2 and 3500 N/cm^2 respectively, find the maximum load the beam can carry.

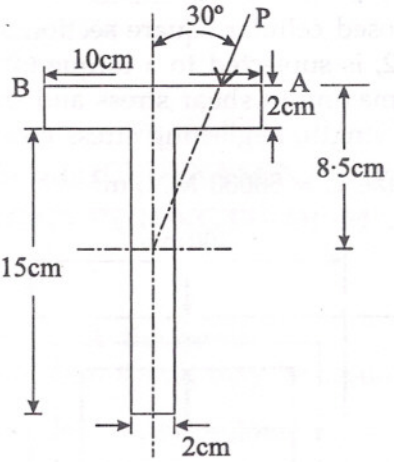

Figure-1

(c) Write short notes on any *Two* of the following :—

(i) Netural Axis

(ii) Disc of Uniform Strength

(iii) Unsymmetrical Bending

4. Answer any *TWO* of the following :— **(6·5×2=13)**

(a) Derive an expression for the axial extension of an open-coiled helical spring produced by an axial load and axial torque.

(b) A helical spring, having 12 coils 20 cm mean coil diameter, is made of 20 mm diameter steel rod. The helix angle is 30°. Find the deflection and angular twist of one of the ends of the spring relative to the other end, if it is subjected to an axial load of 200 N. What are the maximum bending and torsional stresses in the wire ?

Take $E = 200$ GN/m^2 and $G = 80$ GN/m^2.

(c) A closed cellular square section as shown in fig. 2, is subjected to a torque 600 Nm. Find the maximum shear stress and the twist per unit length, neglecting stress concentration.

Take G = 80000 MN/m^2

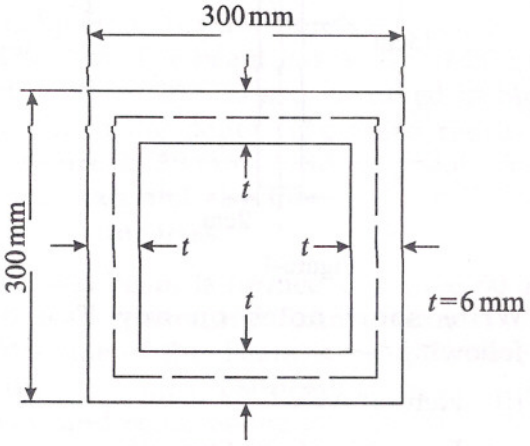

Figure-2