5 Answer any **two** parts :

(a) For curve bar of circular cross-section, derive an expression to determine the distance of centroid from the neutral axis. **10**

(b) A channel section has flanges $b \times t_1$ and web $h \times t_2$. Determine the position of its shear centre. **(Fig. 2)** **10**

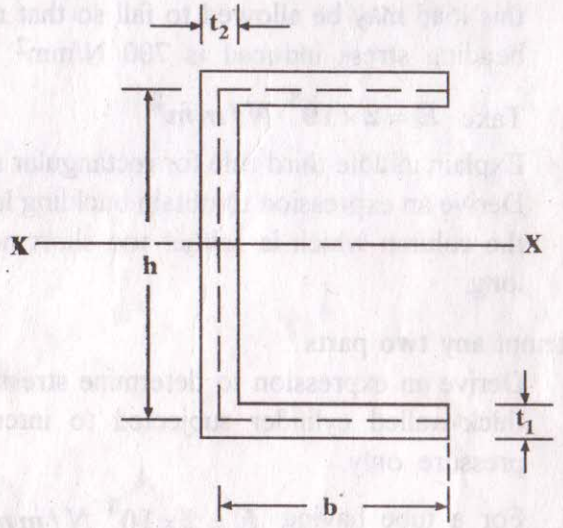

Fig. 2

(c) If principal moments of inertia of section are I_{UU} and I_{VV} then prove that moment of inertia about an axis X–X inclined to an angle θ to U-V axis will be **10**

$$I_{XX} = I_{UU} \cos^2 \theta + I_{VV} \sin^2 \theta .$$

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Printed Pages : 4 **TME-303**

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

PAPER ID : 4071 Roll No.

B. Tech.

(SEM. III) EXAMINATION, 2008-09
STRENGTH OF MATERIAL

Time : 3 Hours] *[Total Marks : 100*

Note : Answer all questions. Assume suitable value for missing data.

1 Answer part (a) and any **two** parts from remaining **parts** :

(a) What is significance of strain compatibility equations ? Write down these compatibility equations. **5**

(b) At a point in a body the normal and shear stresses on two mutually perpendicular planes are given as $\sigma_X = -100\ MN/m^2$, $\sigma_Y = 40\ MN/m^2$, $\tau_{XY} = 50\ MN/m^2$ using Mohr's circle determine principal stresses and their planes. **7.5**

(c) The three principal stresses at a point in a body subjected to a system of loading are 2.5σ (tensile), 1.2σ (tensile) and 0.8σ (compressive). If yield stress for the material is $280\ MN/m^2$, using factor of safety = 2, Poisson's ratio = 0.3, determine the maximum value of σ so that failure may not occur according to principal stress theory and shear stress theory. **7.5**

(d) At a point P in a body the stresses are $\sigma_X = 10000\ N/cm^2$, $\sigma_Y = -5000\ N/cm^2$, $\sigma_Z = -5000\ N/cm^2$, $\tau_{XY} = \tau_{YZ} = \tau_{XZ} = 10000\ N/cm^2$. Determine normal stress on a plane that is equally inclined to all three axes. 7.5

(e) State and explain Castiglinio theorem with an example. 7.5

2 Answer any **two** parts :

(a) A simple supported beam has a flexural rigidity of 24 MN/m^2 and is loaded as shown in **Fig. 1**. Determine the deflections at mid-span. 10

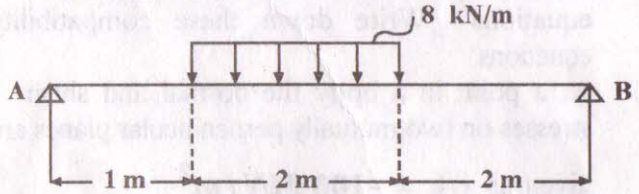

Fig. 1.

(b) A beam of length L and flexural rigidity EI is fixed at both ends at the same level and carries a u.d.l. of intensity per unit length over whole span. Obtain expressions for maximum deflection of the beam. 10

(c) A solid shaft is subjected to a bending moment of 2.3 kN/m and a twisting moment of 3.45 kN/m. Find the diameter of the shaft if the allowable tensile and shear stresses for shaft material are limited to 703 MN/m^2 and 421.8 MN/m^2 respectively. 10

3 Answer any **two** parts :

(a) A cantilever type laminated spring (quarterelleptic) has a span of 0.5 meter. If each leaf be 8 mm thick and 72 mm wide, find the number of leaves so that the spring deflects 60 mm under an end load of 3 kN. Determine maximum bending stress at this load. Also determine the height from which this load may be allowed to fall so that maximum bending stress induced is 700 N/mm^2. 10

Take $E = 2 \times 10^5\ N/mm^2$

(b) Explain middle third rule for rectangular sections. 10

(c) Derive an expression to obtain buckling load for the column which is neither too short nor too long. 10

4 Attempt any **two** parts :

(a) Derive an expression to determine stresses in thick-walled cylinder subjected to internal pressure only. 10

(b) For a tube having $E = 2 \times 10^5\ N/mm^2$ and $\mu = 0.3$ the hoop stress at the inner face is twice the internal pressure. Find the thickness of the wall if internal radius is 60 mm. 10

(c) A spherical tank, has a diameter of 20 meter and wall thickness 15 mm. If the permissible stress in the material is 120 MPa, determine the maximum pressure at which a gas can be stored in the tank. Determine the increase in diameter and volume of the tank, due to gas pressure. Take : E = 200 GPa and Poisson's ratio $(\mu) = 0.3$. 10