50 MPa and external pressure 25 MPa. Find the maximum shear stress at the inner surface of the cylinder.

5. Attempt any **two** of the following : **(10×2=20)**

(a) A curved bar of 30 mm square section has a mean radius of curvature of 45 mm. Assuming the bar to be initially unstressed. Find the stresses at inner and outer surfaces, when a bending moment of 300 Nm is applied to the bar such that it tries to straighten it.

(b) A ring made of 20 mm diameter steel bar has a mean radius of 160 mm. Two loads of 5 kN each are applied along a diameter of the ring. Determine maximum stress in the ring.

(c) A cantilever beam of length 2 m has a rectangular section 40 mm deep and 30 mm wide. It carries a concentrated force of 2 kN at its free end which acts along one of diagonals of the section. Find the maximum stress at the fixed end and direction of neutral axis.

12/12/11

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

PAPER ID : 0429 Roll No.

B.Tech.

(SEM. III) THEORY EXAMINATION 2011-12

STRENGTH OF MATERIALS

Time : 3 Hours *Total Marks : 100*

Note :—Attempt **all** questions. All questions carry equal marks.

1. Attempt any **two** of the following : **(10×2=20)**

(a) An element of material in plane strain undergoes the following strains :

$\epsilon_x = 340 \times 10^{-6}$, $\epsilon_y = 110 \times 10^{-6}$, $\gamma_{xy} = 180 \times 10^{-6}$.

Determine (i) Strain of a line inclined at an angle of 30° from x-axis (ii) Principal strains and (iii) Maximum shear strain.

(b) Determine the total strain energy density and distortion energy density for the following state of stress $\sigma_1 = 600$ MPa, $\sigma_2 = 400$ MPa and $\sigma_3 = -500$ MPa. Given that : E = 200 GPa and $\mu = 0.26$.

(c) Using Castigliano's Theorem, determine the free end deflection of a cantilever beam of length *L*, subjected to a uniformly distributed of intensity *w/m*. Flexural stiffness of the beam is *EI*.

2. Attempt any **two** of the following : **(10×2=20)**

(a) A timber beam 140 mm wide and 180 mm deep is reinforced by 140 mm × 10 mm steel plates at top and bottom. The beam is subjected to a bending moment of 24 *kNm*. Determine the maximum bending stress in the steel and wood. Given that the Young's modulus of steel and wood are 210 GPa and 15 GPa respectively.

(b) A simply supported beam of length 8 m carries two concentrated forces of magnitude 64 kN and 48 kN in downward direction at distances of 1m and 4 m from left end. Find the deflection below the 48 kN load. Take E = 210 GPa and I = 180 $\times 10^6$ mm^4.

(c) A 800 mm long shaft of diameter 80 mm is supported on ball bearings at its ends. It carries a flywheel of weight 4 kN at its middle and transmits a power of 24 kW at a speed of 240 rpm. Determine the principal stress at the ends of a vertical diameter at a section which is just before the middle of the beam.

3. Attempt any **two** of the following : **(10×2=20)**

(a) A close coiled helical spring made of 10 mm diameter steel bar has 8 coils of 150 mm mean diameter. Calculate the elongation, maximum shear stress and strain energy per unit volume when the spring is subjected to an axial load of 130 N. Take G = 80 GPa.

(b) An elliptic type of leaf spring is 800 mm long. Static deflection of spring under a load of 3 kN is 100 mm. Determine the number of leaves required and maximum stress if the leaves are 75 mm wide and 8 mm thick. E = 204 GPa.

(c) A hollow alloy tube having internal and external diameters of 36 mm and 52 mm respectively is 6 m long. It extends by 3 mm when an axial force of 50 kN is applied. Determine crippling load for the tube when used as column with both ends pinned.

4. Attempt any **two** of the following : **(10×2=20)**

(a) Wall thickness of a cylindrical shell of 800 mm internal diameter is 10 mm. Length of the cylinder is 2 m. If the shell is subjected to an internal pressure of 1.5 MPa. Determine maximum shear stress induced and change in dimensions of the shell. E = 200 GPa and $\mu = 0.3$.

(b) A spherical shell of 1.2 m internal diameter and 6 mm thickness is filled with water under pressure until its volume increases by 400 × 10^3 mm^3. Find the pressure exerted by water on the shell. E = 200 GPa and $\mu = 0.3$.

(c) A thick hallow cylinder 200 mm internal and 300 mm external diameter is subjected to an internal pressure