Total number of printed pages – 6

B. Tech
CPME 6202

Fourth Semester Examination – 2008

MECHANICS OF MATERIALS – I

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*
Figures in the right hand margin indicate marks.

1. Answer the following questions : 2 × 10

   (a) Distinguish between major and minor principal planes.

   (b) State moment area theorem.

   (c) Explain torsional rigidity.

   (d) A cantilever beam is subjected to uniformly distributed load. Will there be any point of contra flexure ? Give also reason for answer.

   (e) What do you mean by stiffness of a closed coil helical spring ?

   (f) Will be there any stress due to temperature if a cantilever beam is allowed to expand by increasing temperature ? Give reason in support of your answer.

   (g) Find the section modulous of a hollow circular section having external diameter equal to 1.6 times internal diameter.

   (h) Write the relationship between bending moment and shear force.

   (i) A closed coil helical spring deflects by 34 mm under an axial pull of 0.2 kN. Find the energy stored.

   (j) Define contra flexure.

2. A steel bar is placed between two copper bars each having the same area and length as the steel bar at 25 °C. At this stage they are rigidly connected together at both the ends. When the temperature is raised to 300 °C, the length of the bars increases by 2 mm. Determine the original length and final stresses in the bars.

   Take Es = 210 KN/m^2 and Ec = 100 KN/m^2
   $\alpha_s = 12 \times 10^{-6}$/°C, $\alpha_c = 17.5 \times 10^{-6}$/°C 10

3. A beam 6 meters long is simply supported at the ends and carries a uniformly distributed load of 30 kN/m for a distance of 4 meters from the left end in addition to a clockwise couple of 12 kN-m acting at the centrer of the span. Draw the shear force and bending moment diagram showing point of contra flexure. 10

4. (a) Explain theory of pure bending. 3

   (b) A shell 4 meters long, 1 meter in diameter is subjected to an internal pressure of

   1.2 MPa. If the thickness of the shell is 10 mm, find the circumferential and longitudinal stresses. Find also the maximum shear stress and change in the dimensions of the shell. 7

5. A rosette of three main gauges on the surface of a metal plate under stress gave the following readings

   No 1 at 0° : + 0.00059

   No 2 at 45° : + 0.00031

   No 3 at 90° : – 0.00043

   The angles being measured anticlockwise from gauge No 1. Determine the magnitude of the principal strains and their direction relative to the axis of gauge No 1 if E = 2.1 × 10^5 MPa and modular ratio = 3. Find also the principal stress. 10

6. A beam of span 7 meters and of uniform flexural rigidity EI = 40000 kNm^2 is subjected to a clock-wise couple of 300 kN-m at a distance of 4 meter from the left end. Find the deflection at the point of application of the couple using method of integration. Find also the maximum deflection. 7+3

7. A simply supported beam carries a uniformly distributed load of intensity 30 N/mm over the entire span of 4 meters. The cross section of beam is a 'T' section having flange width 150 mm, rib width 30 mm, flange thickness 25 mm and overall depth of 250 mm. Calculate the maximum shear stress for the section of the beam and draw the shear stress distribution diagram for the section. 10

8. (a) Show that for a given maximum shear stress the minimum diameter required for a solid circular shaft to transmit P kilo watt at N rpm can be expressed as

$$d = k\sqrt[3]{P/N}$$

Where k is a constant ? 3

(b) A hollow shaft is to transmit 350 kW at 90 rpm. If the shear stress is not to exceed 60 N/mm^2 and the internal diameter is 0.6 of the external diameter. Find the external and internal diameters, assuming the maximum torque is 1.4 times the mean torque. 7

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