Reg. No. : | | | | | | | | | | | |

H 2411

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2009.

Fourth Semester

Mechanical Engineering

CE 251 — STRENGTH OF MATERIALS

(Common to B.E. Second Semester Mechatronics Engineering)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State and explain Hooke's law.

2. State Maxwell's reciprocal theorem.

3. Draw shear force diagram for a simply supported beam of 5m span is subjected to a clockwise moment of 15 KN.m at a distance of 2m from the left end.

4. Sketch the bending and shear stress distribution for a "T" section.

5. Show that the shear stress distribution over a rectangular section is parabolic.

6. Define principal plane and principal stress.

7. A cylindrical shell of 500 mm diameter is required to with stand an internal pressure of 4 MPa. Find the minimum thickness of the shell, if maximum tensile strength in the plate material is 400 N/mm^2 and efficiency of joint is 65%. Take factor of safety as 5.

8. State Castigliano's theorem for the deflection of beams.

9. State Maxwell-Betti Reciprocal theorem.

10. Define Strain energy density.

PART B — (5 × 16 = 80 marks)

11. (a) (i) State Moment – Area Mohr's theorems. (4)

(ii) A simply supported beam AB of uniform section, 4m span is subjected to a clockwise moment of 10 KN.m applied at the right hinge B. Derive the equation to the deflected shape of the beam. Locate the point of maximum deflection and find the maximum deflection. (12)

Or

(b) (i) Derive the relation between shear force and bending moment. (6)

(ii) A simply supported beam is loaded as shown in figure 11(b). Draw the shear force and bending moment diagrams. (10)

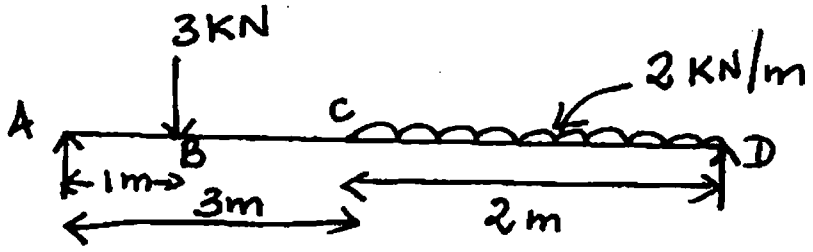

Figure 11(b)

12. (a) A steel rod of 20 mm passes centrally through a copper tube of 50 mm external diameter and 40 mm internal diameter. The tube is closed at each end by rigid plates. If the temperature of the assembly is raised by 50°C, calculate the stresses developed in copper and steel. Take $E_S = 200\ KN/mm^2$, $E_C = 100\ KN/mm^2$, $\alpha_S = 12 \times 10^{-6}$ per°C, $\alpha_C = 18 \times 10^{-6}$ per°C. (16)

Or

(b) A member ABCD is subjected to loads as shown in Fig Q 12(b). Find the value of P and determine the total change in length of the bar.

$E = 210\ KN/mm^2$.

AB = 300 mm, BC = 200 mm, CD = 300 mm. $A_{AB} = 25\ mm^2$, $A_{BC} = 100\ mm^2$, $A_{CD} = 50\ mm^2$. (16)

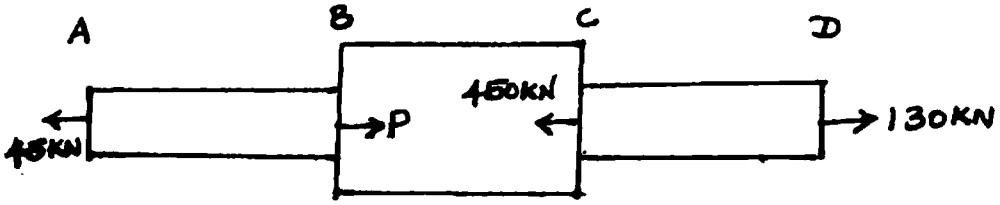

Fig Q 12(b)

13. (a) A cantilever beam of 5 m span carries a point load of 10KN at mid span. Find the deflection at the free end. EI = 360000 KN m^2. (16)

Or

(b) (i) State any four assumptions made in the theory of simple bending. (4)

(ii) Derive the bending formula $\frac{M}{I} = \frac{f}{y} = \frac{E}{R}$. (12)

14. (a) Stresses at a point are $p_x = 80$ N/mm^2, $p_y = -35$ N/mm^2, $q = 11.5$ N/mm^2. Determine principal planes, principal stresses and maximum shear stress. (16)

Or

(b) (i) Derive a relation for deflection of a closely coiled helical spring subjected to an axial downward load W. (8)

(ii) A quarter elliptic leaf spring 60 cm long is made of steel plates of width 10 times the thickness. The spring is to carry a load of 3 KN and the end deflection is limited to 5 cm. The bending stress of the plates must not exceed 3000 N/mm^2. Find suitable values of the size and number of plates to be used. Take $E = 2 \times 10^5$ N/mm^2. (8)

15. (a) Using energy method, find the slope at the ends of a simply supported beam carrying a point load of 50 KN at the centre of the span. Span = 6 m, EI = 360000 KNm^2. (16)

Or

(b) A cantilever of length 2a is carrying a load of W at the free end, and another load of W at its centre. Determine by moment area method, the slope and deflection of the cantilever at the free end. (16)
