Q 2113

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

Second Semester

Mechatronics Engineering

CE 251 — STRENGTH OF MATERIALS

Time-: Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define elastic limit.

2. Write down the expression for thermal stress for a bar of length L and coefficient of thermal expansion α when it is subjected to a rise in temperature t.

3. Draw the BMD for a simply supported beam of span 'L' subjected to two equal point loads of intensity 'W' at 1/3 spans.

4. Draw the SFD for a cantilever beam of span 'L' subjected to a clockwise moment 'M' at the free end.

5. Write down the expression for the section modulus of hollow circular section.

6. Define principal axes.

7. If a shaft rotates by a radian per second under torque T, write down the expression for power transmitted in kilowatt.

8. Write down the expression for the hoop strain for a thin spherical shell of diameter d' and thickness 't'.

9. What is the support condition in conjugate beam for a overhanging support in real beam?

10. Define strain energy due to bending.

11. (a) A bar of 400 mm length is 20 mm in diameter for the first 200 mm and 10 mm in diameter for the remaining 200 mm length. If it is loaded as shown in figure (1), find the total elongation. $E = 2.1 \times 10^5$ N/mm^2.
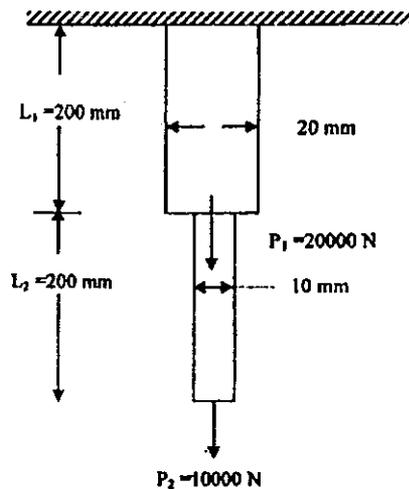

Fig. (1) Qn. 11 (a)

Or

(b) A uniformly tapering bar 20 mm square at top and 10 mm square at bottom is 200 mm long. Find the elongation of the bar under self weight. Given the density as 0.000072 N/mm^3. E = 210 GPa.

12. (a) Draw S.F and B.M diagrams for the cantilever of 4m carrying a uniformly varying load of intensity zero at B to 2000 N/m at A.

Or

(b) Draw S.F. and B.M diagrams for the beam having overhangs on both sides and loaded as shown in fig.(2).
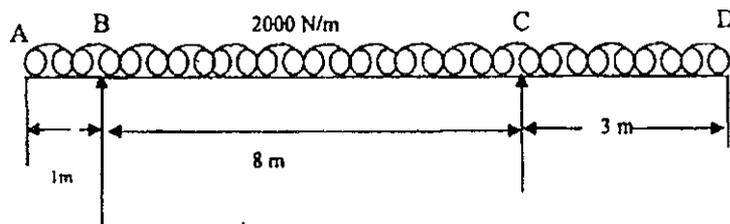

Fig. (2) Qn. 12 (b)

13. (a) A flitched beam is made up of two timber joists each 9 cm wide by 20 cm deep with a 2 cm steel plate 15 cm deep placed symmetrically between them and firmly attached to both. The plate is recessed into grooves cut in the inner faces of the joists so that the overall dimensions of built up

section are 18 cm by 20 cm. Calculate the moment of resistance of the combined section, when the maximum bending stress in timber is 100 N/mm². What is the maximum stress in steel?

$E_{steel} = 0.2$ MN/mm², $E_{timber} = 0.125$ MN/mm².

Or

(b)   A close coil helical spring is suspended from a fixed point by means of a spring and a load of 150 N is suspended from the spring by means of another string at its lower end. Determine the extension of the string due to the above load if the mean diameter of the coil is 5 cm and the number of coils is 20, the diameter of the wire is 5 mm and the modulus of rigidity is 80,000 N/mm². If the load is released by cutting the lower string, find how high the spring will jump. Neglect the extension of the spring. Take the density of steel as 0.000073 N/mm³.

14. (a)   A thin cylinder, 5 cm internal diameter and 1 mm wall thickness is closed at its end, and subjected to an internal pressure of 1 N/mm². If the cylinder is subjected to a torque of 50000 N-mm the axis of which coincides with the axis of cylinder, calculate the principal stresses and maximum shear for a point on the outside surface of the cylinder.

Or

(b)   Find the slope and deflection at the free end of a cantilever subjected to moment M at the free end using strain energy method.

15. (a)   Find the slope and deflection at the free end of a cantilever beam ACB fixed at A and free at B using moment area method. A point load W is acting at B. AC = CB = L/2. Moment of inertia of AC is twice the moment of inertia of BC.

Or

(b)   A beam of constant cross-section 4 metres long is freely supported at its ends. It is loaded at points one metre from each end with load of 2000 N. Find the ratio of the deflections in the centre of the beam to the deflection at the point under one of the loads. Adopt conjugate beam method.