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Question Paper Code : 31143

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2010.

Fourth Semester

Mechanical Engineering

CE 1262 — STRENGTH OF MATERIALS

(Common to Automobile Engineering/Mechatronics Engineering/Metallurgical Engineering and Production Engineering)

(Regulation 2004)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define the term: Elastic limit
2. Give the relation between Young's modulus and Bulk modulus
3. What are the assumptions made in theory of simple bending?
4. Give the relations between load, shear force and bending moment.
5. What do you mean by strength of a shaft?
6. Find the expressions for polar modulus for a solid and hollow shaft?
7. Determine the slope of a simply supported beam subjected to point load at the centre.
8. What is the use of conjugate beam method over other methods?
9. Show that in thin cylinder shells subjected to internal fluid pressure, the circumferential stress is twice the longitudinal stress.
10. Define the terms: Principal planes and principal stresses.

PART B — (5 × 16 = 80 marks)

11. (a) A mild steel rod of 25 mm internal diameter and 400 mm long is enclosed centrally inside a hollow copper tube of external diameter 35 mm and internal diameter of 30 mm. The ends of the tube and rods are brazed together, and the composite bar is subjected to an axial pull of 50kN. If E for steel and copper is 200 GN/m² and 100 GN/m² respectively, find the stresses developed in the rod and tube. Also, find the extension of the rod.

Or

- (b) A copper bar 50 mm in diameter is placed within a steel tube 75 mm in external diameter and 50 mm in internal diameter of exactly the same length. The two pieces are rigidly fixed together by two pins 18 mm in diameter, one at each end passing through the bar and the tube. Calculate the stress induced in the copper bar, steel tube and pins if the temperature of the combination is raised by 50°C. Take $E_s = 210$ GPa, $E_c = 105$ GPa, $\alpha_s = 11.5 \times 10^{-6}$ per °C, $\alpha_c = 17 \times 10^{-6}$ per °C.
12. (a) A shell 4.50 m long, 900 mm in diameter is subjected to an internal pressure of 1.1 N/mm². If the thickness of shell is 8.5 mm, find the circumferential and longitudinal stresses. Find also maximum shear stress and changes in the dimensions of shell. $E = 2.1 \times 10^5$ N/mm²; $1/m = 0.33$.

Or

- (b) A point in a strained material is subjected to mutually perpendicular stress of 600 N/mm² (tensile) and 400 N/mm² (compressive). It is also subjected to a shear stress of 100 N/mm². Draw Mohr's circle, and find the principal stresses and maximum shear.
13. (a) A beam simply supported over a span of 10 m, carries point loads of 40 kN, 20 kN, and 60 kN at 2 m, 5 m and 9 m from the right hand support respectively. Determine the maximum deflection of the beam. Take $E = 0.2$ MN/mm² and $I = 45,200$ cm⁴.

Or

- (b) A hollow cast-iron column with fixed ends supports an axial load of 1 MN. If the external diameter is 25 cm and length is 450 cm, deduce the internal diameter of the column, using Rankine's formula assuming a working stress of 100 N/mm² and the value of constant for cast iron as 1/6400.

14. (a) A hollow steel shaft 10 cm external diameter and 5 cm internal diameter transmits 800 kW at 5000 r.p.m and is subjected to an end thrust of 40,000 N. Find the bending moment that may be safely applied to the shaft if the greater principal stress is not to exceed 100 N/mm².

Or

- (b) A closely coiled helical spring is made of 6 mm wire. The maximum shear stress and the deflection under a load of 200 N is not to exceed 90 N/mm² and 1.1 cm respectively. Determine the number of coils and their mean radius. Take N or $C = 0.84 \times 10^5$ N/mm².
15. (a) A simply supported beam of 6 m span carries a uniformly distributed load of 20 kN/m over the middle 2 m length and point loads of 10 kN and 20 kN at a distance of 1 m and 5 m from the left end. Draw the shear force and bending moment diagrams and determine the magnitude and position of the maximum bending moment.

Or

- (b) An R.S. Joist 55 cm by 19 cm having flange and web thicknesses 1.5 cm and 0.99 cm respectively, is used as a beam. If at a section, it is subjected to shear force of 100 kN, find the greatest intensity of shear stress in the beam taking,
- (i) Web vertical.
- (ii) Web horizontal. Show the variation of shear stress in both cases.