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

Question Paper Code : 80197

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Third Semester

Mechanical Engineering

CE 6306 — STRENGTH OF MATERIALS

(Common to Mechatronics Engineering, Industrial Engineering and Management, Agriculture Engineering, Industrial Engineering, Manufacturing Engineering, Mechanical Engineering (Sandwich), Materials Science and Engineering and also Common to Fourth Semester Automobile Engineering, Mechanical and Automation Engineering and Production Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Define Young's Modulus.
2. What do you mean by principal planes and principal stresses?
3. Draw the shear force diagram and bending moment diagram for the cantilever beam carries uniformly varying load of zero intensity at the free end and w kN/m at the fixed end.
4. List out the assumptions used to derive the simple bending equation.
5. Define torsional rigidity.
6. What is a spring? Name the two important types of springs.
7. List out the methods available to find the deflection of a beam.
8. State Maxwell's reciprocal theorem.
9. Name the stresses develop in the cylinder.
10. Define radial pressure in thin cylinder.

PART B — ($5 \times 13 = 65$ marks)

11. (a) (i) A compound tube consists of a steel tube 140 mm internal diameter and 160 mm external diameter and an outer brass tube 160 mm internal diameter and 180 mm external diameter. The two tubes are of same length. The compound tube carries an axial compression load of 900 kN. Find the stresses and the load carried by each tube and the amount of its shortens. Length of each tube is 140 mm. Take E for steel as 2×10^5 N/mm^2 and for brass 1×10^5 N/mm^2. (10)

(ii) Two members are connected to carry a tensile force of 80 kN by a lap joint with two number of 20 mm diameter bolt. Find the shear stress induced in the bolt. (3)

Or

(b) (i) A point in a strained material is subjected to the stress as shown in fig. Q.11(b)(i). Locate the principle plane and find the principle stresses. (7)

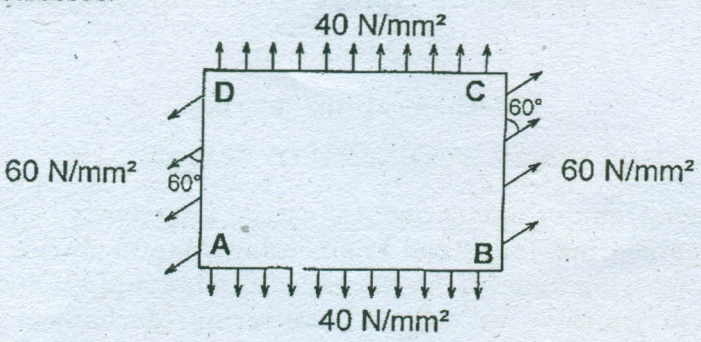


Fig. Q. 11(b)(i)

(ii) A steel rod of 20 mm diameter passes centrally through a copper tube of 50 mm external diameter and 40 mm internal diameter. The tube is closed at the end by rigid plates of negligible thickness. The nuts are tightened lightly on the projecting parts of the rod. If the temperature of the assembly is raised by 50°C, calculate the stresses developed in copper and steel. Take E for steel as 2×10^5 N/mm² and copper as 1×10^5 N/mm² and α for steel and copper as 12×10^{-6} per °C and 18×10^{-6} per °C. (6)

12. (a) (i) A simply supported beam AB of length 5 m carries point loads of 8 kN, 10 kN and 15 kN at 1.50 m, 2.50, and 4.0 m respectively from left hand support. Draw shear force diagram and bending moment diagram. (8)

(ii) A cantilever beam AB of length 2 m carries a uniformly distributed load of 12 kN/m over entire length. Find the shear stress and bending stress, if the size of the beam is 230 mm × 300 mm. (5)

Or

(b) (i) Construct the SFD and BMD for the beam shown in fig. Q. 12(b)(i). (6)

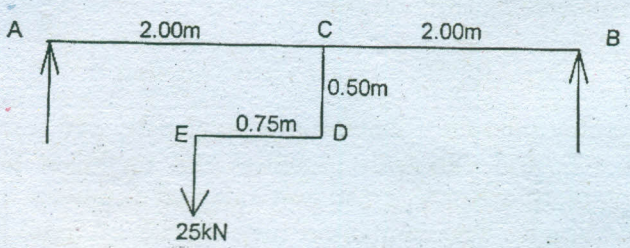
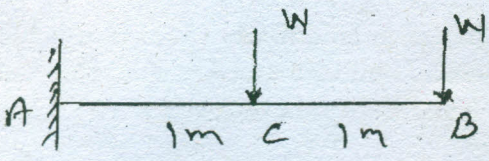


Fig. Q. 12(b)(i)

(ii) Two timber joist are connected by a steel plate, are used as beam as shown in fig. Q. 12(b)(ii). Find the load W if, the permissible stresses in steel and timber are 165 N/mm² and 8.5 N/mm² respectively. (7)



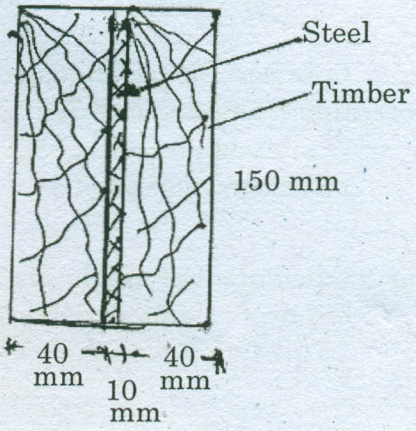


Fig. Q. 12(b)(ii) Cross section

13. (a) (i) A solid shaft has to transmit the Power 105 kW at 2000 r.p.m. The maximum torque transmitted in each revaluation exceeds the mean by 36%. Find the suitable diameter of the shaft, if the shear stress is not to exceed 75 N/mm² and maximum angle of twist is 1.5° in a length of 3.30 m and $G = 0.80 \times 10^5$ N/mm². (8)

(ii) A laminated spring carries a central load of 5200 N and it is made of 'n' number of plates, 80 mm wide. 7 mm thick and length 500 mm. Find the numbers of plates, if the maximum deflection is 10 mm. Let $E = 2.0 \times 10^5$ N/mm². (5)

Or

(b) (i) A stepped solid circular shaft is built in at its ends and subject to an externally applied torque T at the shoulder as shown in fig. Q.13(b)(i). Determine the angle of rotation θ of the shoulder section when T is applied. (7)

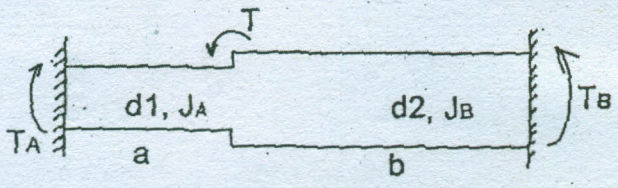


Fig. Q.13(b)(i)

(ii) A closed coiled helical spring is to be made out of 5 mm diameter wire 2 m long so that it deflects by 20 mm under an axial load of 50 N. Determine the mean diameter of the coil. Take $C = 8.1 \times 10^4$ N/mm². (6)

14. (a) Cantilever of length l carrying uniformly distributed load w kN per unit run over whole length. Derive the formula to find the slope and deflection at the free end by double integration method. Calculate the deflection if, w = 20 kN /m, l = 2.30 m and EI = 12000 kN m². (13)

Or

(b) (i) Derive the formula to find the deflection of a simply supported beam with point load W at the centre by moment area method. (8)

(ii) A simply supported beam of span 5.80 m carries a central point load of 37.50 kN, find the maximum slope and deflection, let EI = 40000 kN m^2. Use conjugate beam method. (5)

15. (a) Calculate Change in diameter, Change in length and Change in volume of a thin cylindrical shell 100 cm diameter, 1 cm thick and 5 m long when subjected to internal pressure of 3 N/mm^2. Take the value of E = 2×10^5 N/mm^2 and Poisson's ratio = 0.30. (13)

Or

(b) Calculate the thickness of metal necessary for a cylindrical shell of internal diameter 160 mm to with stand an internal pressure of 25 MN/m^2, if maximum permissible shear stress is 125 MN/m^2. (13)

PART C — (1 × 15 = 15 marks)

16. (a) The intensity of resultant stress on a plane AB (Fig.Q.16(a)) at appoint in a materials under stress is 8 N/mm^2 and it is inclined at 30° to the normal to that plane. The normal component of stress on another plane BC at right angles to plane AB is 6 N/mm^2. Determine the following :

(i) The resultant stress on the plane BC

(ii) The principal stresses and their directions

(iii) The maximum shear stresses. (15)

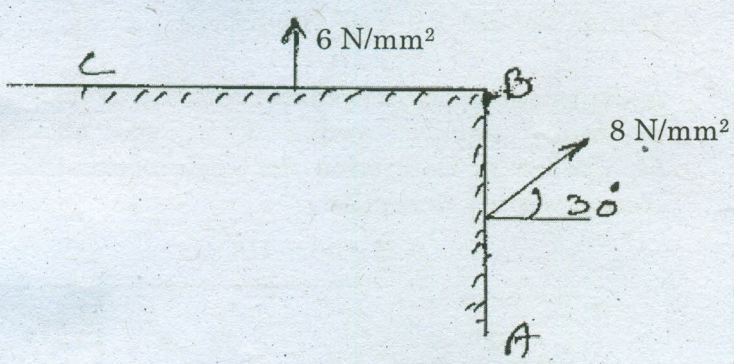


Fig. Q. 16(a)

Or

(b) A water tank vertical wall is stiffened by vertical beam, and the height of the tank is 8 m. The beams are spaced at 1.5 m centre to centre. If the water reaches the top of the tank, calculate the maximum bending moment on a vertical beam. Sketch the shear force and bending moment diagrams. Unit weight weight of water = 9.8 kN/m^3. (15)