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Question Paper Code : 60244

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

Third Semester

Civil Engineering

CE 2201/CE 34/CE 1202 A/10111 CE 304/080100010 – MECHANICS OF SOLIDS

(Regulations 2008/2010)

[Common to 10111 CE 304 – Mechanics of solids for B.E. (Part-Time) First Semester – Civil Engineering – Regulations 2010]

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is meant by limit of proportionality and shear modulus?

2. Define principal stresses and principal planes.

3. Mention the methods available to analyse the forces in truss members.

4. Differentiate thin cylinders and thick cylinders.

5. Where will be the maximum bending moment in a beam?

6. What is meant by point of contraflexure?

7. What is the difference between Real Beam and conjugate beam?

8. Distinguish between shear flow and shear centre.

9. Draw the stress distribution for a shaft of circular section subjected to torsion.

10. What are the uses of leaf springs?

PART B — (5 × 16 = 80 marks)

11. (a) A railway line is laid so that there is no stress in the rails at 8°C. Calculate

(i) the stress on the rails at 50°C if there is no allowance for expansion between two rails.

(ii) the stress in the rails at 50°C if there is an expansion allowance of 8mm per rail.

(iii) the expansion allowance if the stress in the rail is to be zero when the temperature is 50°C

(iv) the maximum temperature to have no stress in the rails if the expansion allowance is 12mm per rail. The rails are 30m long. Take $\alpha = 12 \times 10^{-6}$ per $°C$ and $E = 2 \times 10^5 N/mm^2$. (16)

Or

(b) (i) At a point in an elastic material under strain, there are normal stresses of 60 N/mm² and 40 N/mm² (both tensile) respectively at right angles to each other, with positive shearing stress of 20 N/mm². Find

(1) Principal stresses and the position of principal planes and

(2) Maximum shear stress and its plane. (8)

(ii) A metallic bar 250 mm × 100 mm × 50 mm is loaded as shown in Fig 11(b) (ii). Find the change in volume. Take $E = 200 kN/mm^2$ and Poisson's ratio = 0.25. Also find change that should be made in the 4000 kN, in order that there should be no change in the volume of the bar. (8)

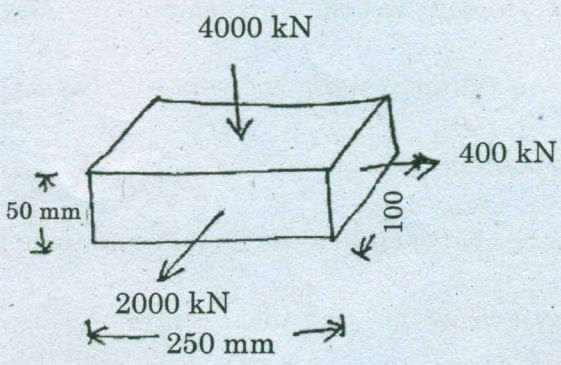

Fig 11(b) (ii)

12. (a) Determine the forces in all the members of the truss shown In Figure Q.12 (a) using method of joints.

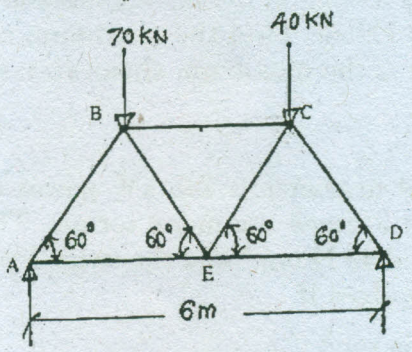

Figure Q.12 (a)

Or

(b) A cylindrical shell 3 m long which is closed at the ends has an internal diameter of 1 m and a wall thickness of 15 mm. Calculate the circumferential and longitudinal stresses induced and also change in the dimensions of the shell if it is subjected to an internal pressure of 1.5 MN/m^2.

13. (a) Draw shear force and bending moment diagram for the beam given in Fig Q. 13(a).

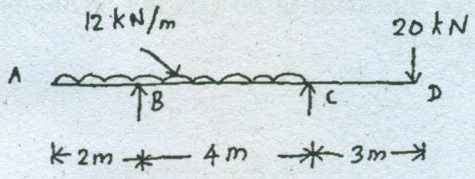

Fig Q. 13(a)

Or

(b) State the assumptions made in the theory of simple bending and derive the bending formula.

14. (a) A cantilever of 3 m length and of uniform rectangular cross section 150 mm wide and 300 mm deep with a 30 kN load at the free end. In addition to this it carries a uniformly distributed load of 20 kN/m run over its entire length as in Fig. 14 (a)

Take $E = 210$ GN/m^2

Calculate:

(i) The maximum slope and maximum deflection

(ii) The slope and deflection at 2 m from the fixed end.

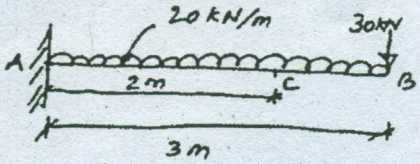

Fig. 14 (a)

Or

(b) A timber beam 150 mm × 250 mm in cross-section is simply supported at its ends and has a span of 3.5 m. The maximum safe allowable stress in bending is 7500 kN/m^2. Find the maximum safe U.D.L. which the beam can carry. What is the maximum shear stress in the beam for the U.D.L. calculated? (16)

15. (a) A shaft required to transmit 245 kW power at 240 rpm. The maximum torque may be 1.5 times the mean torque. The shear stress in the shaft should not exceed 40 N/mm^2 and the twist 1°per metre length. Determine the diameter required if

(i) The shaft is solid

(ii) The shaft is hollow with external diameter twice the internal diameter.

Take modulus of rigidity = 80 kN/mm^2.

Or

(b) A closed coil spring has mean diameter of 75mm and spring constant of 90 kN/m. It has 8 coils. What is the suitable diameter of the spring wire if maximum shear stress is not to exceed 250 MN/m^2? Modulus of rigidity of the spring wire material is 80 GN/m^2. What is the maximum axial load the spring can carry?