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

Question Paper Code : 80241

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Third Semester

Civil Engineering

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

(Regulations 2008/2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What do you mean by Stiffness?

2. With a simple sketch explain lateral strain.

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

4. Differentiate thin cylinders and thick cylinders.

   Define circumferential stress and longitutidinal stress in a thin cylinder with relevant equations for the above stresses.

5. Define Point Load, uniformly distributed load, uniformly varying load.

6. Define Point of contra flexure.

7. What is the equation for maximum deflection at free end of a cantilever beam of span L, with an udl load of w per meter length?

8. What is meant by conjugate beam and how to determine the slope and deflection of real beam from conjugate beam?

9. What is torque?

10. List out the types of springs.

PART B — (5 × 16 = 80 marks)

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

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

(ii) the stress in the rails at 50ºC 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 50ºC

(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 $\alpha = 12 \times 10^{-6} \text{per}^{\circ}C$ 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)

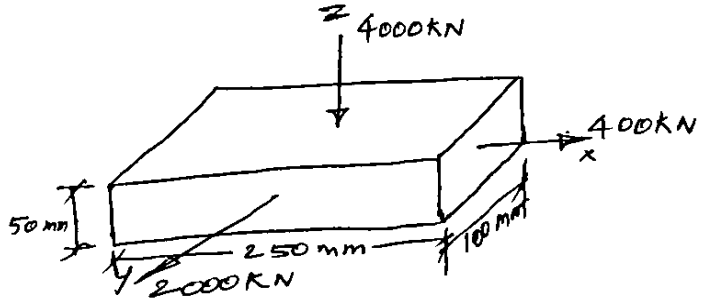

fig.11(b)(ii)

12. (a) Determine the forces in all the members of the frame shown in Fig.Q 12(a). Use method of joints. (16)

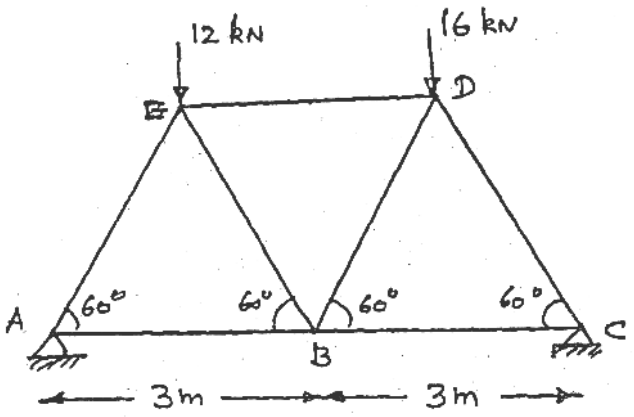

Fig.Q.12(a)

Or

(b) Derive relations for change in length, thickness and volume of a thin cylinder subjected to an Internal pressure. Also explain the failure of thin cylinders. (16)

13. (a) Draw the shear force and bending moment diagrams for the beam shown in fig.13(a). Clearly mark the position of the maximum bending moment and determine its value. (16)

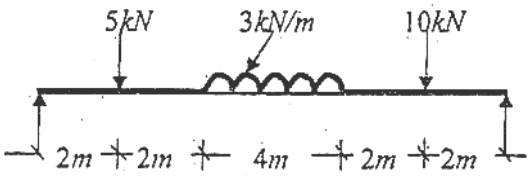

fig.13(a)

Or

(b) The moment of inertia of a symmetrical section of a beam about its neutral axis is 2640 cm^4 and its depth is 20 cm. Determine the, longest span over which, when simply supported, the beam would carry a UDL of 6 kN/m run without the stress due to bending not exceeding 1.2×10^5 N/mm^2. (16)

14. (a) A cantilever of 3 m length and of uniform rectangular cross section 150 mm wide and 300 mm deep is loaded with a 30 kN load at the 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. (8)

(ii) The slope and deflection at 2 m from the fixed end. (8)

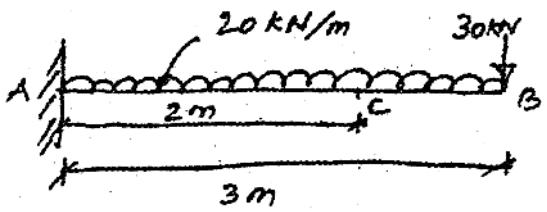

fig.14(a)

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 solid steel shaft is subjected to a torque of 45 kNm. If the angle of twist is 0.5 degrees per meter length of the shaft and the shear stress is not to be allowed to exceed 90 MN/m^2, find (i) Suitable diameter for the shaft (ii) Final maximum shear stress, and (iii) Maximum shear strain in the shaft. Take C = 80 GN/ m^2. (16)

Or

(b) An open coiled helical spring of wire diameter 12 mm, mean coil radius 84 mm, helix angle 20 degrees carries an axial load of 480 N. Determine the shear stress and direct stress developed at inner radius of the coil.(16)

———————