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Question Paper Code : 70275

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

Third Semester

Civil Engineering

CE 6302 — MECHANICS OF SOLIDS

(Common to Environmental Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Assume suitable data if found necessary.

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. State Hooke's Law.

2. Define Resilience.

3. Differentiate statically determinate and indeterminate beams.

4. What is point of contraflexure?

5. A beam 3 m long , simply supported at its ends, is carrying a point load at its centre. If the slope at the ends is 1°, find the deflection at the mid span of the beam.

6. What is a conjugate beam?

7. Write an expression for stain energy stored in a shaft of uniform section subjected to torsion.

8. Mention the uses of springs.

9. What is the use of Mohr's circle?

10. What are Deficient and Redundant frames?

PART B — (5 × 13 = 65 marks)

11. (a) A composite bar is made with a copper flat of size 50 mm × 30 mm and a steel flat of 50 mm × 40 mm of length 500 mm each placed one over the other. Find the stress induced in the material, when the composite bar is subjected to an increase in temperature of 90°C. Take coefficient of thermal expansion of steel as $12 \times 10^{-6} /^{\circ} C$ and that of copper as $18 \times 10^{-6} /^{\circ} C$, Modulus of elasticity of steel = 200 GPa and Modulus of elasticity of copper = 100 GPa.

Or

(b) A thin cylindrical shell, 2 in long has 800 mm internal diameter and 10 mm thickness If the shell is subjected to an internal pressure of 1.5 MPa, find

(i) the hoop and longitudinal stresses developed,

(ii) maximum shear stress induced and

(iii) the changes in diameter, length and volume. Take modulus of elasticity of the wall material as 205 GPa, and Poisson's ratio as 0.3.

12. (a) A cantilever 1.5 m long is loaded with a uniformly distributed load of 2 kN/m run over a length of 1.25 m from the free end (Figure 12 (a). It also carries a point load of 3 kN at a distance of 0.25 m from the free end. Draw the shear force and bending moment diagrams of the cantilever.(13)

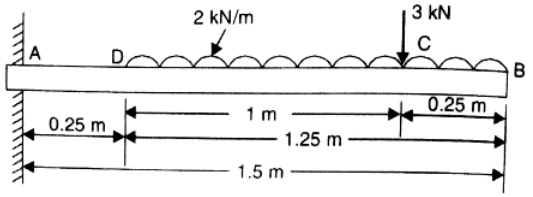

Figure – 12 (a)

Or

(b) A beam is simply supported and carries a uniformly distributed load of 40 kN/m run over the whole span. The section of the beam is rectangular having depth as 500 mm. If the maximum stress in the material of the beam is 120 N/mm^2 and moment of inertia of the section if 7×10^8 mm^4, find the span of the beam. (13)

13. (a) A steel girder of uniform section 14 metres long is simply supported at the ends. It carries concentrated loads of 90 kN and 60 kN at two points 3 metres and 4.5 metres from the two ends respectively. Calculate: the deflection of the girder at the points under the two loads and the maximum deflection. Take $E = 210 \times 10^6 kN/m^2$ and $I = 64 \times 10^{-4} m^4$.

Or

(b) For the beam shown in figure 13 (b), determine the following :

(i) Slope at end A,

(ii) Deflection at the midspan.

(iii) Maximum deflection.

Take $E = 200 \times 10^6 kN/m^2$ and $I = 8 \times 10^{-5} m^4$.

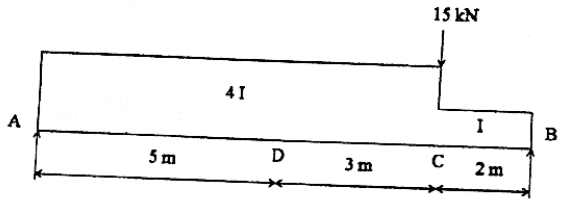

Figure – 13 (b)

14. (a) A circular shaft is required to transmit a power of 220 kW at 200 rpm. The maximum torque may be 1.5 times the mean torque and the shear stress in the shaft not to exceed 50 N/mm^2. Determine the diameter required if

(i) the shaft is solid

(ii) the shaft is hollow with external diameter twice the internal diameter twice the internal diameter. Take modulus of rigidity = 80 kN/mm^2.

Or

(b) A bumper is to be designed to arrest a wagon weighing 500 kN moving at 80 km/hour Details of buffer springs available are: diameter = 30 mm, mean radius = 100 mm, number of turns = 18, modulus of rigidity = 80 kN/mm^2 and maximum compression permitted = 200 mm. Determine the number of springs required for the buffer.

15. (a) An element has a tensile stress of 600 N/mm^2 acting on two mutually perpendicular planes' and shear stress of 100 N/mm^2 on these planes. Find the principal stress and maximum shear stress.

Or

(b) Determine the forces in all members of a cantilever truss as shown in Figure (15 (b).

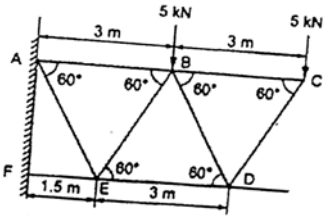

Figure – 15 (b)

PART C — (1 × 15 =15 marks)

16. (a) A steel girder of 6 m length acting as a simply supported beam carries a uniformly distributed load w N/m run throughout its length. If $I = 30 \times 10^{-6} m^4$ and depth 270 mm, calculate

(i) The magnitude of w so that the maximum stress developed in the beam section does not exceed 72 MN/m^2.

(ii) The slope and deflection in the beam at a distance of 1.8 m from one end. Take : E = 200 GPa.

Or

(b) A wagon weighing 18 kN is moving at 5 km/hr. How many springs each of 20 coils will be required in a buffer stop to absorb the energy of motion during a compression of 175 mm. The mean diameter of coils is 250 mm and the diameter of steel rod, comprising the coil is 22 mm. Take C = 82GPa.

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