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THIRD SEMESTER B.TECH. (ENGINEERING) [14 SCHEME] DEGREE EXAMINATION, NOVEMBER 2015

ME 14 304—MECHANICS OF SOLIDS

Time : Three Hours Maximum : 100 Marks

Part A

Answer any **eight** *questions.*

1. A rod of 150 cm. long and of diameter 2 cm. is subjected to an axial pull of 20 kN. If the modulus of elasticity of the material of the rod is 2×10^5 N/mm^2 , determine :
   (i) Stress ;
   (ii) Strain ; and
   (iii) Elongation of the rod.
2. Sketch stress-strain diagrams for ductile and brittle materials and compare it.
3. A bar of 30 mm. diameter is subjected to a pull of 100 kN. The measured extension on a gauge length of 250 mm. is 0.15 mm. and the change in diameter is 0.00475 mm.
   Calculate (i) Young's modulus, (ii) Poisson's ratio and (iii) Bulk modulus.
4. 'A hollow shaft has greater strength and stiffness than solid shaft of equal weight'-Justify.
5. Sketch the shear force and bending moment diagrams for a simply supported beam carrying a uniformly varying load from zero at one end to '*w*' per unit length at the other end.
6. What do you mean by 'simple bending' ? What are the assumptions made in the theory of simple bending ? Prove that the bending stress in any fibre of a beam is proportional to the distance of the fibre from the neutral layer.
7. A cantilever 2 m. long carries a uniformly distributed load over the entire length. Find the deflection at the free end if the slope at the free end is 1.25°.
8. The tensile stresses at a point across two mutually perpendicular planes are 120 N/mm^2 and 60 N/mm^2. Determine the normal and tangential stresses on a plane inclined at 30 ° to the axis of the minor stress.
9. A body is subjected to direct stresses in two mutually perpendicular directions. How will you determine graphically the resultant stress on an oblique plane when the stresses are unequal and unlike ?

Turn over

10. Calculate the safe compressive load on a hollow cast iron column (one end rigidly fixed and other hinged) of 15 cm. external diameter, 10 cm. internal diameter and 10 m. in length. Use Euler's formula with a factor of safety of 5 and E = 95 kN/mm^2.

(8 × 5 = 40 marks)

Part B

Answer **all** *the questions.*

11. (a) A member ABCD is subjected to point loads Pl, P2, P3 and P4 as shown in the Figure 1. Calculate the force P2 necessary for equilibrium if P1 = 45 kN, P3 = 450 kN and P4 = 130kN. Determine the total elongation of the member, assuming the modulus of elasticity to be 2.1 × 10^5 N/mm^2.

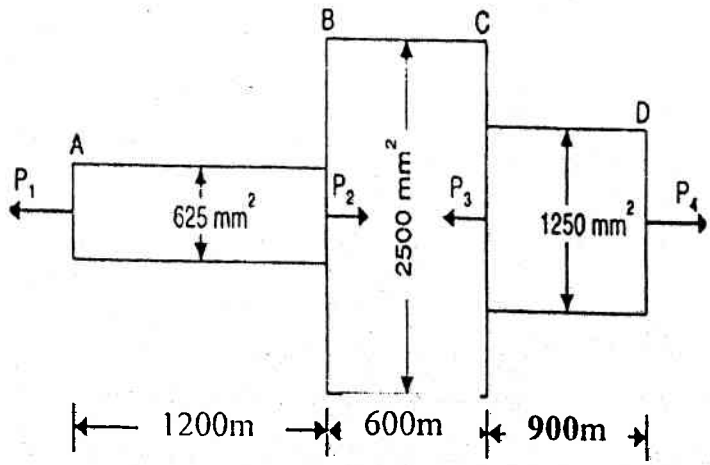

Figure 1

Or

(b) The concrete post (shown in Figure 2) (E_c = 25 GPa and α_c = 9.9 × 10^{-6}/^{0}C) is reinforced with six steel bars, each of 22 mm diameter (E_s = 200 GPa and α_s = 11.7 × 10^{-6}/^{0}C). Determine the normal stresses induced in the steel and in the concrete by a temperature rise of 35°C.

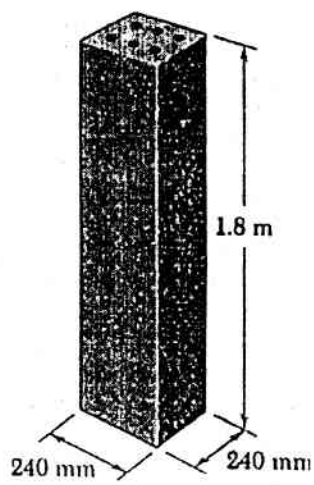

Figure 2

12. (a) A solid circular shaft is to transmit 400 kW at 150 rpm.

(i) Find the diameter of the shaft if the shear stress is not to exceed 60 N/mm^2.

(ii) What percent saving in weight would be obtained if this shaft is replaced by a hollow shaft whose internal diameter equal to 2/3rd of its external diameter, the length, the material and maximum shear stress being the same ?

Or

(b) Draw the shear force and bending moment diagrams for a simply supported beam of length 8 m and carrying a uniformly distributed load of 10 kN over a distance of 4m as shown in Figure 3 :

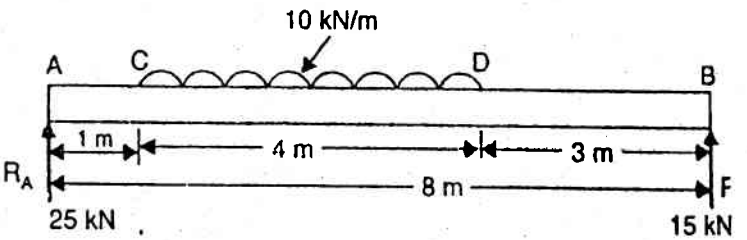

Figure 3

13. (a) A beam of T-section as shown in Figure 4. The beam is simply supported over a span of 4 m and carries a uniformly distributed load of 1.7 kN/m run over the entire span. Determine the maximum tensile and compressive stress.

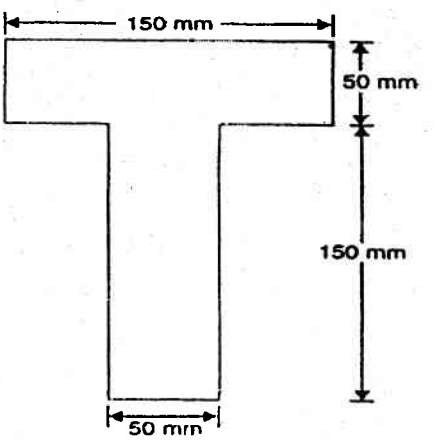

Figure 4

Or

(b) A beam of length 20 m is simply supported at its ends and carries two point loads of 4 kN and 10 kN at a distance of 8 m and 12 m from left end respectively. Calculate: (i) deflection under each load (ii) maximum deflection. Take $E = 2 \times 10^6$ N/mm^2 and $I = 1 \times 10^9$ mm^4.

14. (a) An element in a stressed material has tensile stress of 500 MN/m^2 and a compressive stress of 350 MN/m^2 acting on two mutually perpendicular planes and equal shear stresses of 100 MN/m^2 on these planes. Determine the magnitude and directions of principal stress and maximum shear stress.

Or

(b) Obtain an expression for the Euler's crippling load when one end of the column is fixed and the other end is free.

(4 × 15 = 60 marks)