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Reg. No.....

THIRD SEMESTER B.TECH. (ENGINEERING) [09 SCHEME] DEGREE EXAMINATION, NOVEMBER 2014

CE 09 303/PTCE 09 302—MECHANICS OF SOLIDS

Time : Three Hours Maximum : 70 Marks

Part A

Answer **all** *questions.*
Each question carries 2 *marks.*

1. Define normal stress and shear stress.
2. Define thin and thick cylinder.
3. An alloy specimen has modulus of elasticity of 120 GPa and modulus of rigidity of 45 GPa. Determine the Poisson's ratio of the material.
4. Sketch the bending stress as well as shear stress distribution for a beam of rectangular cross-section.
5. What are the assumptions made in Euler's column theory ?

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*
Each question carries 5 *marks.*

6. In an experiment, a bar of 30 mm. diameter is subjected to a pull of 60 kN. The measured extension on gauge length of 200 mm. is 0.09 mm. and the change in diameter is 0.0039 mm. Calculate the Poisson's ratio and the value of the three modulii.
7. A point in a strained material is subjected to two mutually perpendicular tensile stress of 200 MPa and 100 MPa. Determine the intensions of normal, shear and resultant stresses on a plane inclined at 30° with the axis of the minor tensile stress.
8. Derive a relation for change in length of a bar hanging freely under its own weight.
9. State the assumptions bending and derive the bending formula.
10. A cantilever 1.5 m. long carries a load of 2 tons at its free end, and another load 1 ton/m. throughout the span. Draw shear force and bending moment diagrams for the cantilever.
11. Define (i) crippling load ; (ii) effective length of column.

(4 × 5 = 20 marks)

Turn over

Part C

Answer **all** *questions.*
Each question carries 10 *marks.*

12. A cast iron flat 30 mm. long and 30 mm. (thickness) × 60 mm. (width) uniform cross-section, is acted upon by the following forces :—

    30 kN tensile in the direction of the length ; 360 kN compression in the direction of the width ; 240 kN tensile in the direction of the thickness.

    Calculate the direct strain, net strain in each direction and change in volume of the flat. Assume the modulus of elasticity and Poisson's ratio for cast iron as 140 kN/mm^2 and 0.25 respectively.

Or

13. Two vertical rods one of steel and other of copper are each rigidly fixed at the top and 600 mm. apart. Diameters and lengths of the rods are 25 mm. and 5 m. respectively. A cross bar fixed to the rods at the lower end carries a load of 7 kN such that the cross bar remains horizontal even after loading. Find the steps in each rod and the position of the load on the cross bar. Assume the modulus of elasticity for steel and copper as 200 kN/mm^2 and 100 kN/mm^2 respectively.

14. A beam of size 150 mm. wide, 250 mm. deep carries a uniformly distributed load of w kN/m. over entire span of 4 m. A concentrated load 1 kN is acting at a distance of 1.2 m. from the left support. If the bending stress at a section 1.8 m. from the left support is not to exceed 3.25 N/mm^2 find the load w.

Or

15. A beam of length 6 m. is simply supported at its ends and carries two point loads of 48 kN and 40 kN at a distance of 1 m. and 3 m. respectively from the left support.

    Find (i) Deflection under each load ; (ii) Maximum deflection ; (iii) The point at which the maximum deflection occurs.

    Take E = 2×10^5 N/mm.^{2} ; I = 85×10^6 mm^4

16. A simply supported beam AB of span 4 m., carrying a load of 100 kN at its mid span C has cross-section moment of inertia 24×10^6 mm^4 over the left half of the span and 48×10^6 mm^4 over the right half. Find the slope at two supports and the deflection under the load. Take E = 200 GPa.

Or

17. A simply supported beam of span 10 m. carries an uniformly distributed load of 5 kN/m. over the entire span. Using Castigliano's theorem determine :

    (i) The mid-span deflection of the beam.

    (ii) The slope at the left support.

18. A cylindrical vessel 2 m. long and 500 mm. in diameter with 10 mm. thick plates is subjected to an internal pressure of 3 MPa. Calculate the change in volume of the vessel. Take E = 200 GPa and Poisson's ratio = 0.3 for the vessel material.

Or

19. A column with one end hinged and other end fixed has a length of 5 m. and a hollow circular cross-section of outer dia 100 mm. and wall thickness 10 mm. If E = 1.60×10^5 N/mm^2 and crushing stress σ_c = 350 N/mm^2, find the load that the column may carry with a factor of safety of 2.5 according to Euler theory and Rankine theory.

(4 × 10 = 40 marks)