Hall Ticket No | | | | | | | | | | Question Paper Code: ACE001

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech III Semester End Examinations (Regular) - December, 2017

Regulation: IARE – R16

Strength of Materials - I

(Civil Engineering)

Time: 3 Hours **Max Marks: 70**

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

UNIT – I

1. (a) Derive the expression for young's modulus in terms of bulk modulus. **[7M]**

   (b) The bar shown in Figure 1 is subjected to a tensile load of 160 kN. If the stress in the middle portion is limited to 150 N/mm^2, determine the diameter of the middle portion. Find also the length of the middle portion if the total elongation of the bar is to be 0.2 mm. Young's modulus is given as equal to 2.1 x 10^5 N/mm^2. **[7M]**

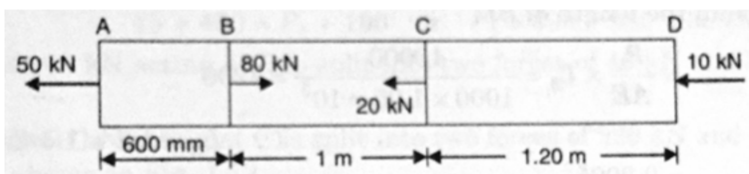

Figure 1

2. (a) Determine the principal stresses when a member subjected to direct stresses in two mutually perpendicular directions accompanied by a simple shear stress. **[7M]**

   (b) The principal stresses at a point in an elastic material are 200 N/mm^2 (tensile), 100 N/mm^2 (tensile) and 50 N/mm^2 (compressive stresses). If the stresses at the elastic limit in simple tension is 200 N/mm^2, determine whether failure of material will occur or not according to maximum strain energy theory. Take Poisson's ratio= 0.3. **[7M]**

UNIT – II

3. Draw the BMD and SFD for the beam as shown in Figure 2. **[14M]**

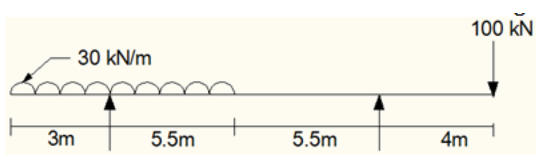

Figure 2

4. Draw the shear force and bending moment diagrams for the overhanging beam carrying uniformly distributed load of 2 kN/m over the entire length and a point load of 2 kN as shown in Figure 3. Locate the point of contraflexure. **[14M]**

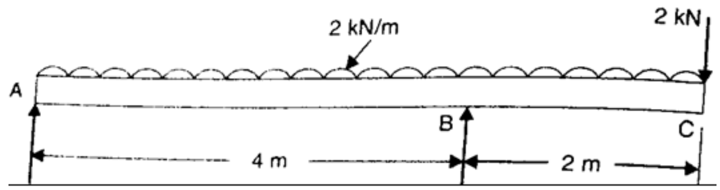

Figure 3

UNIT – III

5. (a) Determine the section modules for rectangular section, circular section and hollow circular section. **[7M]**

   (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 the moment of inertia of the section is 7 x 10^8 mm^4, find the span of the beam. **[7M]**

6. (a) A hollow steel tube having external and internal diameter of 100 mm and 75mm respectively is simple supported over a span of 5 m. The tube carries a concentrated load of W at a distance of 2 m from one of the supports. What is the value of W, if the maximum bending stress is not to exceed 100 MPa. **[7M]**

   (b) A beam of square section is used as a beam with one diagonal horizontal. Find the maximum shear stress in the cross section of the beam. Also sketch the shear stress distribution across the depth of the section. **[7M]**

UNIT – IV

7. A hallow shaft of diameter ratio 3/8 (internal dia. to outer dia.) is to transmit 375 kW power at 100 r.p.m. The maximum torque being 20% greater than the mean. The shear stress is not to exceed 60 N/mm^2 and twist in a length of 4 m not to exceed 2°. Calculate its external and internal diameters each would satisfy both the above conditions. Assume modulus of rigidity C = 0.85 x 10^5 N/mm^2. **[14M]**

8. (a) A closely coiled helical spring is to carry a load of 500 N. Its mean coil diameter is to be 10 times that of the wire diameter. Calculate these diameters if the maximum shear stress in the material of the spring are to be 80 N/mm^2. **[7M]**

   (b) A closely coiled helical spring made of 10mm diameter steel wire has 15 coils of 100 mm mean diameter. The spring is subjected to an axial load of 100N. Calculate **[7M]**

   (i) maximum shear stress induced.

   (ii) Deflection

   (iii) stiffness of spring. Take C = 8.16 x 10^4 N/mm^2

UNIT – V

9. (a) Derive the Euler's crippling load for column with both ends fixed. **[7M]**

   (b) A mild steel column having a height of 4 m has thin annular section with average diameter of 300 mm and wall thickness of 10 mm. It is subjected to a vertical load P acting at an eccentricity of 60 mm, when both ends are fixed. The maximum compressive stress is limited to 35 N/mm^2 with E = 2.1 x 10^5 N/mm^2. Find the maximum value of load P it can carry. **[7M]**

10. A 1.5 m long column has a circular cross section of 5 cm diameter. One of the ends of the column is fixed in direction and position and other end is free. Taking factor of safety as 3, calculate the safe load using: **[14M]**

    (i) Rankine's formula, take yield stress, σ_c = 560 N/mm^2 and a = 1/1600 for pinned ends.

    (ii) Euler's formula, young's modulus for Cast Iron= 1.2 x 10^5 N/mm^2.

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