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Question Paper Code: AME004

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

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

Regulation: IARE – R16

MECHANICS OF SOLIDS

(Mechanical 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) State Hook's law. Draw the stress strain diagram for mild steel and explain in detail about different stresses on it. **[7M]**

   (b) A steel plate of thickness 16 mm tapers uniformly from 80 mm at one end to 50 mm at other end in length of 800 mm. If the plate is subjected to a load of 120 kN, find the extension of the plate Take E = 2×10^5 MPa. Also calculate the percentage error if the average area is used for calculating its extension. **[7M]**

2. (a) Derive the relationship between three elastic constants E,C,K. State the importance of these constants.

   [7M]

   (b) A brass bar having cross section area of 1000 mm^2, subjected to axial forces as shown in Figure 1. Determine the stress at each section. **[7M]**

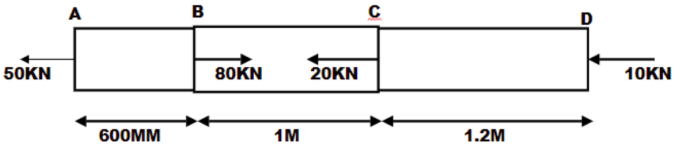

Figure 1

UNIT – II

3. (a) Derive the expression for shear force and bending moment diagrams for a cantilever with point load at free end. **[7M]**

   (b) A cantilever of length 2 m carries a uniformly distributed load of 1 kN/m run over a length of 1.5 m from the free end. Draw the shear force and bending moment diagram for cantilever. **[7M]**

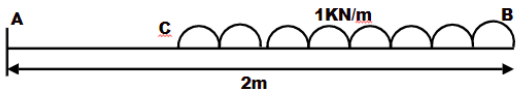

Figure 2

4. (a) A cantilever of length 2.0 m carries a uniformly distributed load of 1 kN/m run over a length 1.5 m from the free end.Draw the Shear force and Bending moment diagrams for the Cantilever. **[7M]**

   (b) A 10 m long simply supported beam carries two point loads of 10 kN and 6 kN at 2 m and 9 m respectively from the left end. It also has a uniformly distributed load of 4 kN/m run for the length between 4 m and 7 m from the left end. Draw the Shear force and Bending moment diagrams. **[7M]**

UNIT – III

5. (a) What are the assumptions made in deriving the bending equation. Derive the relationship between bending stress and radius of curvature **[9M]**

   (b) A simply supported beam of I section carries a UDL of 40 kN/m on entire span of beam of length 3 m. If I section is having dimensions as shown in Figure 3. Determine the maximum stress produced due to bending. **[5M]**

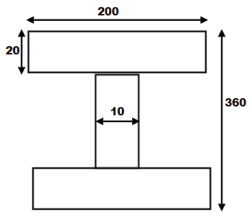

Figure 3

6. (a) A I Section has the following dimensions flanges 200 × 10 mm; web 380 × 8 mm. The maximum shear stress developed in the beam is 20 N/mm^2. Find the shear force to which the beam is subjected. **[7M]**

   (b) A beam of T section has a length of 2.5 m and is subjected to point load W, T section is shown in Figure 4. Calculate the compressive, bending stress and plot the stress distribution across the cross section of beam. The maximum tensile stress is limited to 300 MPa. Calculate the value of point load W. **[7M]**

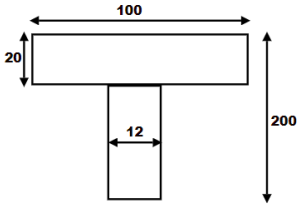

Figure 4

UNIT – IV

7. (a) Describe the procedure of calculating the principal stresses by using Mohr's circle method when a body is subjected to two mutually perpendicular principal tensile stresses of unequal intensities. **[7M]**

   (b) At point in a stressed body, the stresses act as shown in Figure 5. Calculate the values of **[7M]**

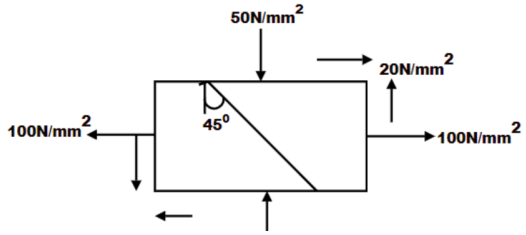

Figure 5

   i. Normal and tangential stress on plane inclined at 45° with the vertical
   ii. Principal stresses
   iii. Orientation of principal stress
   iv. Maximum shear stress and its direction

8. (a) Explain briefly about maximum shear stress theory and Maximum normal stress theory. **[7M]**

   (b) A mild steel shaft of 100 mm diameter is subjected to a maximum torque of 12 kNm and a maximum bending moment of 8 kNm at a particular section. Determine the factor of safety according to Maximum shear stress theory if the elastic limit of mild steel in simple tension is 240 MPa. **[7M]**

UNIT – V

9. (a) Derive the Torsion equation. **[7M]**

   (b) A hollow steel shaft transmits 200 KW of power at 150 rpm. The total angle of twist in a length of 5 m of the shaft is 30. Find the inner and outer diameters of the shaft if the permissible shear stress is 60 MPa. G = 80 GPa. **[7M]**

10. (a) Derive the expressions for Circumferential and longitudinal stresses in a thin cylindrical shell. **[7M]**

    (b) A spherical shell of 1.2 m internal diameter and 6 mm thickness is filled with water under pressure until the volume is increased by 400 X 10^3 mm^3.Find the pressure exerted by water on the shell. Take E = 20 GPa and poisson's ratio = 0.3. **[7M]**

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