Hall Ticket No | | | | | | | | | | | Question Paper Code: AME004

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Four Year B.Tech III Semester End Examinations (Supplementary) - July, 2018

Regulation: IARE – R16

MECHANICS OF SOLIDS

Time: 3 Hours **(ME)** **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 of total elongation for tapered rectangular bar. **[7M]**

   (b) The bar shown in the 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 bar is to be 0.2 mm. Young's modulus is equal to 2.1 N/mm^2. **[7M]**

Figure 1

2. (a) Define the terms : (i) Elasticity (ii) Hooke's law(iii) Young's Modulus (iv) Modulus of rigidity **[7M]**

   (b) A steel tube of 30 mm external diameter and 20 mm internal diameter encloses a copper rod of 15 mm diameter to which it is rigidly joined at each end.If at a temperature of 10^0 C, there is no longitudinal stress,calculate the stresses in the rod and tube when the temperature is raised to 200^0C.Take E for steel and copper as 2.1X10^5 N/mm^2 and 1X 10^5 N/mm^2 respectively.The value of coefficient of linear expansion for steel and copper is given as 11 X10^{-6} /^{0} C and 18X $10^{-6}/^0$ C respectively. **[7M]**

UNIT – II

3. (a) Explain the sign conventions used for Shear force and Bending moment. **[7M]**

   (b) Draw the S.F and B.M diagrams of a simply supported beam of length 7 m carrying uniformly distributed loads as shown in Figure 2. **[7M]**

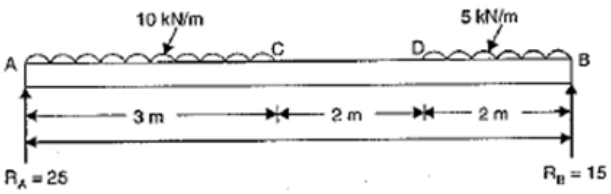

Figure 2

4. (a) Derive the relation between load, shear force and bending moment. **[7M]**

   (b) A simply supported beam of 8 m length carries three point loads of 8 kN,4kN and 10 kN at 2 m,5 m and 6 m respectively from the left end. Draw the Shear force and Bending moment diagrams. **[7M]**

UNIT – III

5. (a) State the assumptions involved in the theory of Simple bending. **[7M]**

   (b) Two wooden planks 150 mm X 50 mm each are connected to form a T-section of a beam. If a moment of 3.4 kNm is applied around the horizontal neutral axis, inducing tension below the neutral axis, find the stresses at the extreme fibres of the cross-section. **[7M]**

6. (a) State the assumptions made in deriving bending equation and derive the bending equation with usual notations. **[7M]**

   (b) A beam of I section shown in Figure 3 has 200mm×300mm has web thickness 10mm and flange thickness 10mm. It carries a shearing force of 10 kN at a section. Sketch the shear stress distribution across the section. **[7M]**

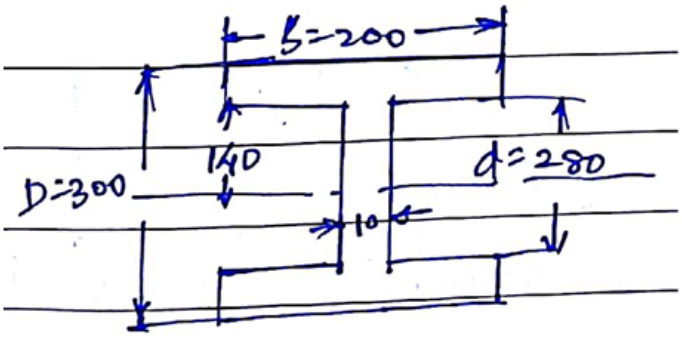

Figure 3

UNIT – IV

7. (a) Derive the equations of principal stresses for the beam which is subjected to two mutually perpendicular normal stresses. **[7M]**

   (b) The stresses on two perpendicular planes through a point in a body are 160 MPa and 100 MPa,both compressive along with a shear stress of 80 MPa. Determine (i) the normal and shear stresses on a plane inclined at 30^0 to the plane of 160 MPa stress. Find also the resultant stress and its direction.(ii) The normal stress on a plane at 90^0 to the inclined plane mentioned in (i). **[7M]**

8. (a) Schematically explain stress tensor Write a note on principal stresses and derive the equation for the stresses on member subjected to biaxial stress normal to the inclined plane. **[7M]**

   (b) At point in a stressed body, the stresses act as shown in Figure 4. Determine the values of normal and tangential stresses on plane inclined at 45^0 with vertical. **[7M]**

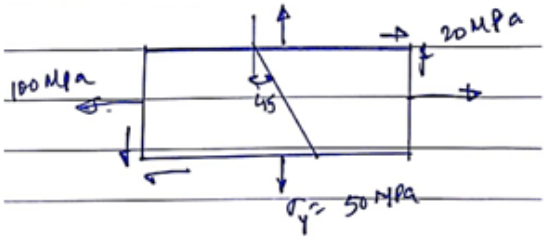

Figure 4

UNIT – V

9. (a) State the assumptions in the derivation of shear stress produced in a circular shaft subjected to torsion. **[7M]**

   (b) A hollow steel shaft, having an internal diameter 40 % of its external diameter, transmits 562.5 kW power at 100 rpm. Determine the external diameter of the shaft if the shear stress is not to exceed 60 N/mm^2 and the twist in a length of 2.5 m should not exceed 1.3 degrees. Assume maximum torque = 1.25 of the mean torque and modulus of rigidity = 9X 10^4 N/mm^2. **[7M]**

10. (a) State the difference between thick and thin cylinders **[7M]**

    (b) A thin cylinder shell 1m in diameter and 3m long has a metal thickness of 10mm. It is subjected to an internal fluid pressure of 3 MPa. Determine **[7M]**

    i. Circumferential and longitudinal stress
    ii. Circumferential and longitudinal and volumetric strain
    iii. Change in length , diameter and volume, also find the maximum shearing stress in the shell. Assume poisson's ration as 0.3, E=210 GPa

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