Hall Ticket No | | | | | | | | | | | Question Paper Code: AAEB04

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Four Year B.Tech III Semester End Examinations(Regular) - November, 2019

Regulation: IARE – R18

MECHANICS OF SOLIDS

Time: 3 Hours **(AE)** **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) Find an expression for the total elongation of a uniformly tapering rectangular bar when it is subjected to an axial load P. **[7M]**

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

2. (a) Prove that the maximum stress induced in a body due to suddenly applied load is twice the stress induced when the same load is applied gradually. **[7M]**

   (b) A circular rod of 25 mm diameter and 500 mm long is subjected to a tensile force of 60 kN. Determine modulus of rigidity, bulk modulus and change in volume if Poisson's ratio = 0.3 and Young's modulus E = 2×10^5 N/mm^2. **[7M]**

UNIT – II

3. (a) Define shear force, bending moment, SFD, BMD and deduce the relation between SF, BM and UDL. **[7M]**

   (b) A cantilever of length 3 m is carrying a point load of 50KN at a distance of 2m from the fixed end. If I= 10^8 mm^4 and E=2x10^5N/mm^2 find the slope and deflection at the free end. **[7M]**

4. (a) Prove the relation that $M = EI\frac{\partial^2 y}{\partial x^2}$. **[7M]**

   (b) A simply supported beam of length 5M carries a uniformly distributed load of 800N/m. Draw the shear force and bending moment diagrams for the beams. Calculate the position and magnitude of maximum bending moment. **[7M]**

UNIT – III

5. (a) Determine relation between average shear stress and maximum shear stress of rectangular section beam due to shear force. **[7M]**

   (b) A rectangular beam 100mm wide and 150mm deep is subjected to a shear force of 30kN. Determine the average stress, max shear stress. **[7M]**

6. (a) Draw and explain shear stress distribution across circular section due to shear force. **[7M]**

   (b) A circular beam of diameter 150mm is subjected to a shear force of 70KN. Find the value of maximum shear stress. **[7M]**

UNIT – IV

7. (a) Discuss limitations of Euler's column theory. **[7M]**

   (b) The external and internal diameter of a hollow cast iron column are 5cm and 4 cm respectively. If the length of this column is 3m and both of its ends a fixed. Determine the crippling load using Rankine's formula. Take the values of crushing stress =550N/mm^2 and a=1/1600 in Rankine's formula. **[7M]**

8. (a) Derive the expression for crippling load of a column when both ends are hinged. **[7M]**

   (b) A solid bar 4m long and 6 cm in diameter is used as a strut with both ends hinged. Determine the crippling load. Take E= 2 × 10^5N/mm^2. **[7M]**

UNIT – V

9. (a) Derive the compatibility equation for two-dimensional problem. **[7M]**

   (b) A cantilever of length L and depth 2h is in a state of plane stress. The cantilever is of unit thickness, is rigidly supported at the end x=L and is located as shown in Figure 1. Show that stress function φ = Ax^2+Bx^2y+C$y3$+D(5$x^2$4y^3-y^5) is valid for the beam and evaluate the constants A,B,C and D. **[7M]**

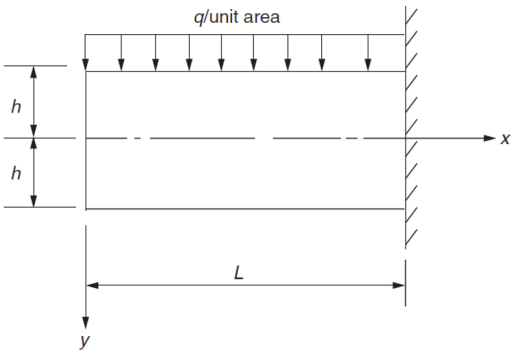

Figure 1

10. (a) Explain Mohr's circle construction for bi axial stress system with neat sketch. **[7M]**

    (b) Rectangle bar of cross sectional area 10000mm^2 is subjected to an axial load of 20kN. Determine the normal and shear stress on a section which is inclined at an angle of 30^o to the vertical. **[7M]**