16AG5AC319

Code No: 123AC **R15**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year I Semester Examinations, November/December - 2016
MECHANICS OF SOLIDS
(Common to ME, MCT, MMT, AE, AME, MSNT)

Time: 3 Hours Max. Marks: 75

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit.
Each question carries 10 marks and may have a, b, c as sub questions.

PART- A
(25 Marks)

1. a) Define the term shear strain. Represent it graphically. [2]
   b) The Young's modulus and Poisson's ratio for a material is given by 200 GPa and 0.3. Find the modulus of rigidity and the bulk modulus. [3]
   c) Distinguish between roller support and the hinged support. [2]
   d) A simply supported beam of length L is applied by a moment M at the midspan. Draw the shear force and bending moment diagram. [3]
   e) Write the equation describing the shear stress distribution over the cross section of a beam and explain the terms involved in it. [2]
   f) A 120 mm wide and 10 mm thick steel strip is bent into a circular arc of 8 m radius. Determine the stress induced if the Young's modulus of the strip is 200 GPa. [3]
   g) Present the maximum principal stress theory graphically. [2]
   h) What is Mohr's stress circle? How is it useful in the solution of stress analysis problems? [3]
   i) List the assumptions made in the analysis of thin cylinders. [2]
   j) Explain the terms: Polar Sectional Modulus, Torsional Rigidity and Torsional Stiffness. [3]

PART-B
(50 Marks)

2. A steel rod of 40 mm diameter is fitted in a copper tube of 60 mm external diameter and 40 mm internal diameter. The assembly is completely fixed at one end while other end is constrained in cross section by rigid plate. If the temperature of the assembly is raised by 60 ^{0}C, calculate the stresses developed in copper and steel. Consider the following material properties.
   Young's modulus for steel = 200 GPa;
   Young's modulus for copper = 100 GPa
   Coefficient of thermal Expansion for steel = 12×10^{-6} per ^{0}C
   Coefficient of thermal Expansion for copper = 18×10^{-6} per ^{0}C. [10]

OR

3. A titanium bar with square cross section with 75 mm side and length 3.0 m is subjected to tensile load of 900 kN along the length direction. Determine the change in the dimensions and increase in volume of the bar. Young's modulus and Poisson's ratio for titanium are 100 GPa and 0.33 respectively. Determine the strain energy developed in the body. What is the increase in the strain energy if the same load is suddenly applied? [10]

4. A cantilever beam is loaded as shown in the figure 1. Plot the shear force and bending moment diagrams. Also find the reactions at the fixed support. What is the bending moment at a distance of 0.5 m from the fixed support? [10]

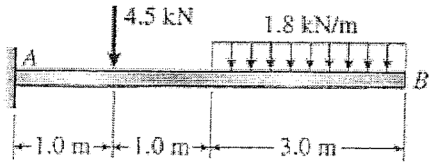

Figure: 1

OR

5.a) Derive the relation between Shear Force, Bending Moment and rate of loading at a section of a beam.

b) The shear force diagram for a cantilever beam of length 3 m is varying linearly from a value of 12 N at the fixed end to a value of zero at the free end. Determine the loading on the cantilever beam. [5+5]

6. The tension flange of a cast iron I section beam is 240 mm wide and 50 mm deep, the compression flange is 100 mm wide and 20 mm deep where as the web is 300 mm deep and 30 mm thick. Find the load per unit run which can be carried over a 4 m span of a simply supported beam if the maximum permissible stresses are 90 MPa in compression and 24 MPa in tension. [10]

OR

7. The simply supported wood beam in figure 2 is fabricated by gluing together three 160-mm by 80-mm planks as shown. Calculate the maximum shear stress at the glue position and at the neutral axis. [10]

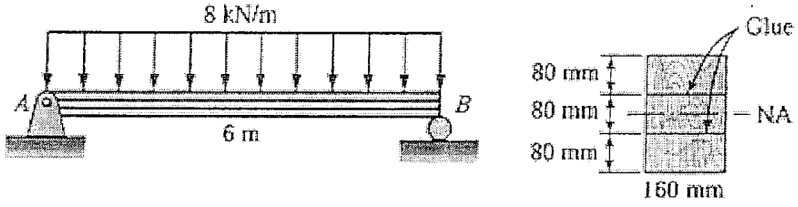

Figure: 2

8. An element in plane stress is subjected to the stresses in the directions shown in figure 3. Determine the stresses acting on an element oriented at a counter clockwise angle of 40^0 from the horizontal. Show these stresses on a sketch of an element oriented at this angle. Also find the principal stresses and maximum shear stresses along with their orientations. [10]

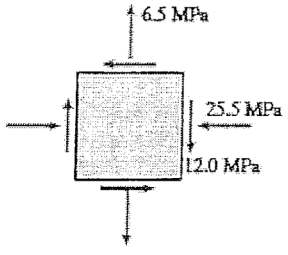

Figure: 3

OR

9. A bolt is subjected to an axial pull of 9 kN and a transverse shear of 4.5 kN. Determine the diameter of the bolt if the elastic limit in tension is 225 MPa using maximum principal stress theory and the maximum shear stress theory. Assume a factor of safety of 3. [10]

10. A hollow shaft having an internal diameter 50% of its external diameter transmits 600 kW of power a 200 rpm. Determine the external diameter of the shaft if the shear stress is not to exceed 65 MPa and the twist in the length of 3 m shaft should not exceed 1.5 degrees. Take modulus of rigidity = 100 GPa. [10]

OR

11. A cylindrical vessel is 1.5 m diameter and 4 m long is closed at ends by rigid plates. It is subjected to an internal pressure of 3 MPa. If the maximum principal stress is not to exceed 150 MPa, find the thickness of the shell. Also find the changes in diameter, length and volume of the shell. Take Young's modulus = 200 GPa and Poisson's ratio = 0.25. [10]

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