**R16**

Code No: 133BT

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**B.Tech II Year I Semester Examinations, November/December - 2017**

**STRENGTH OF MATERIALS – I**

**(Common to CE, CEE)**

**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 elasticity and plasticity. [2]
   b) What is beam of uniform strength? [3]
   c) Define point of Contra-flexure. [2]
   d) Draw the SFD, BMD for a cantilever loaded with a clockwise couple of 'M' at the free end. [3]
   e) Sketch the shear stress variation across the depth of the beam of circular cross section. [2]
   f) What is the flexure formula? Explain the terms in it. [3]
   g) What is the differential equation of deflected curve of a beam? [2]
   h) A Simply supported beam subjected to a clockwise couple at the centre. Sketch the elastic curve. [3]
   i) Explain the Strain Energy and deduce the expression due to gradual loading. [2]
   j) Explain maximum principal stress theory. [3]

## PART-B

**(50 Marks)**

2. a) A load of 2 MN is applied on a short column 500 mm × 500 mm. The column is reinforced with four steel bars of 10 mm dia, one in each corner. Find the stresses in the concrete and steel bars. Take E for steel as $2.1 \times 10^5$ N/mm$^2$ and for concrete as $1.4 \times 10^4$ /mm$^2$.
   b) A rod is 2 m long at a temperature of $10^0$ C. Find the expansion of the rod when the temperature is raised to $80^0$ C. If this expansion is prevented, find the stresses induced in the material of the rod. Take E=$1 \times 10^5$ MN/m$^2$ and $\alpha = 12 \times 10^{-6}$ /$^0$C. [5+5]

**OR**

3. A steel bolt of diameter 10 mm passes through a brass tube of internal diameter 15 mm and external diameter 25 mm. The bolt is tightened by a nut so that the length of tube is reduced by 1.5 mm. If the temperature of the assembly is raised by 40°C, estimate the axial stresses in the bolt and the tube before and after heating. Material properties for steel and brass are: $E_S = 2 \times 10^5$ N/mm$^2$, $\alpha_S = 1.2 \times 10^{-5}$/$^0$C and $E_b = 1 \times 10^5$ N/mm$^2$ $\alpha_b = 1.9 \times 10^{-5}$/$^0$C. [10]

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4. An overhanging beam is shown in Figure 1. Draw the Shear Force and Bending Moment diagrams. [10]

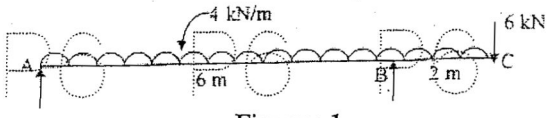


**Figure: 1**

**OR**

5. A beam 6m long is simply supported at the ends and carries a uniformly distributed load of 15 k N/m and three concentrated loads of 10 k N, 20k N and 30 k N acting respectively at the left quarter point, centre point and right quarter point. Draw the shear force and bending moment diagrams and determine the maximum bending moment. [10]

6. A 120 mm × 50 mm I-section is subjected to a shearing force of 10 kN. Calculate the shear stress at the neutral axis and at the top of the web. Given $I = 220\times10^4$ mm$^4$, Area = $9.4\times10^2$ mm$^2$, web thickness = 3.5 mm and flange thickness = 5.5 mm. [10]

**OR**

7. A T-section beam with 100 mm × 15 mm flange and 150 mm × 15 mm web is subjected to a shear force of 12 kN at a section. Draw the variation of shear stress across the depth of the beam and obtain the value of maximum shear stress of the section. [10]

8. A beam ABC of length 9 m is simply supported. The beam carries a point load of 12 kN at right end and also carries a udl of 4 kN/m over a length of 3m as shown in figure 2. Determine the slope and deflection at a point C. Take E = 2 × $10^5$ MN/m$^2$ and I = 5 × $10^8$ mm$^4$. [10]

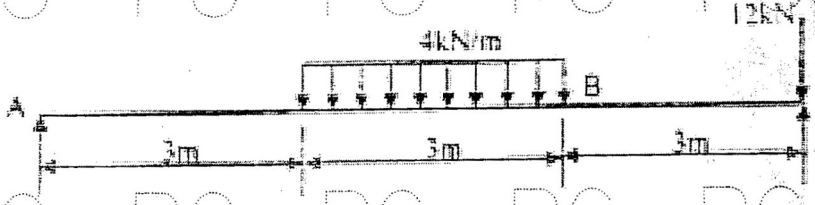


**Figure: 2**

**OR**

9. A cantilever of uniform cross-section of length l carries two point loads, W at the free end and 2W at a distance 'x' from the free end. Find the maximum deflection due to this loading. [10]

10. Direct stresses of 120 MPa tension and 90 MPa compression are applied to an elastic material at a certain point on the planes at right angles. The maximum principal stress is limited to 150 MPa. What is the corresponding shear stress on the given planes and what is the maximum shearing stress at that point. [10]

**OR**

11. If the principal stresses at a point in an elastic material are 2f tensile, 1.5f tensile and f compressive, calculate the value of 'f' at failure according to the maximum principal strain theory. The elastic limit in simple tension is 210 N/mm$^2$ and Poisson's ratio is 0.30. [10]

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