18AE/AS33

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Third Semester B.E. Degree Examination, July/August 2021
Mechanics of Materials

Time: 3 hrs.   Max. Marks: 100

Note: *Answer any FIVE full questions.*

1   a. Draw and explain stress-strain curves for Brittle and Ductile materials. **(10 Marks)**
    b. Show that extension produced due to self weight of a bar of uniform C/S fixed at one end and suspended vertically is equal to half the extension produced by a load equal to self weight applied at freed end. **(10 Marks)**

2   a. Obtain the relation between E, G and K. **(10 Marks)**
    b. A Reinforced short concrete column 250×250 in section is reinforced with 8 steel bars. The total area of steel bars is $1608.5mm^2$. The column carries a load of 270 kN. If the modular ratio is 18, find the stress in concrete and steel.
        If the stress in concrete shall not exceed $4N/mm^2$, find the area of steel required so that column may support a load of 400kN. **(10 Marks)**

3   Draw SFD and BMD for a simply supported beam shown in Fig.Q.3. **(20 Marks)**

Fig.Q.3
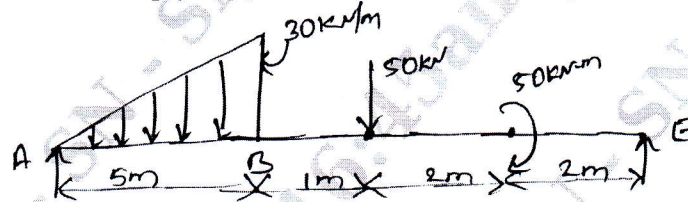
4   A 'T' section of flange 120mm $\times$ 12mm and overall depth of 200mm with 12mm web thickness is loaded, where moment is 20kNm and shear force of 120kN. Sketch bending and shear stress distribution. **(20 Marks)**

5   a. A cantilever beam 2m long is carrying a load of 20kN at its free end and 30kN at a distance of 1m from the free end. Find the slope and deflection at the free end. Take $I = 15 \times 10^7 mm^4$ and $E = 2 \times 10^5 N/mm^2$. **(10 Marks)**
    b. Using standard notation, derive an expression for deflection, slope and maximum deflection of simply supported beam of span 'L' subjected to concentrated load W at its mid span. **(10 Marks)**

6   a. Derive an expression for Euler's crippling load for a column when both ends are fixed. **(06 Marks)**
    b. Determine the diameter of solid shaft which will transmit 440kW at 280rpm. If maximum torsional shear stress is $40N/mm^2$. Take $G = 84kN/mm^2$. **(04 Marks)**
    c. Determine the crippling load for a 'T' section of dimensions 100mm $\times$ 100mm $\times$ 20mm and length of column 12m with both ends fixed. Take E = 210 GPa. **(10 Marks)**

7 a. Define principle of virtual work with neat diagram, with suitable example. (05 Marks)
   b. Define principle of complementary virtual work. (05 Marks)
   c. Determine the bending moment at point 'B' in simply supported beam ABC. (Refer Fig.Q.7(c)). (10 Marks)
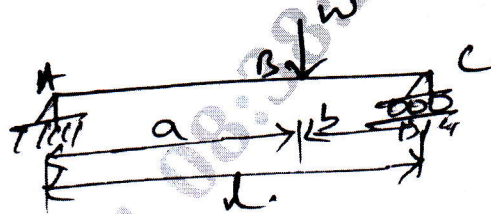

Fig.Q.7(c)

8 a. Define Castigliano's theorem. (03 Marks)
   b. A simply supported beam of span 'l' carries a point load 'F' at mid-span. Determine the strain energy stored by beam. Also find the deflection at mid-span. (07 Marks)
   c. Fig.Q.8(c) shows two bars AB and CB are pinned at A, B and C subjected to a Horizontal applied force 'F' at B. Using Castiglianos theorem, determine the horizontal and vertical displacement of 'B'. (10 Marks)
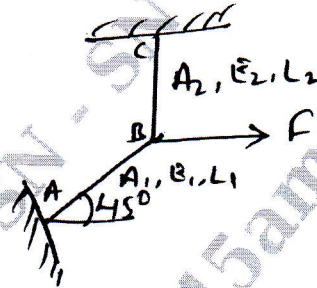

Fig.Q.8(c)

9 a. Explain different types of fracture. (06 Marks)
   b. Define creep properties and stress relaxation. (08 Marks)
   c. Explain three stages of creep. (06 Marks)

10 a. With neat sketch, explain R.R Moore rotating beam test with S.N. diagram for ferrous metals. (10 Marks)
   b. Define fatigue loading with examples. (05 Marks)
   c. Write different properties of fatigue loading. (05 Marks)

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