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18CV32

Third Semester B.E. Degree Examination, July/August 2022
Strength of Materials

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain: (i) Stress   (ii) Strain   (iii) Modulus of Elasticity   **(06 Marks)**
   b. Define four elastic constraints.   **(08 Marks)**
   c. Determine the stresses in various segments of circular bar shown in the Fig.Q1(c). Also compute the total elongation taking Young's modulus E = 195 GPa.

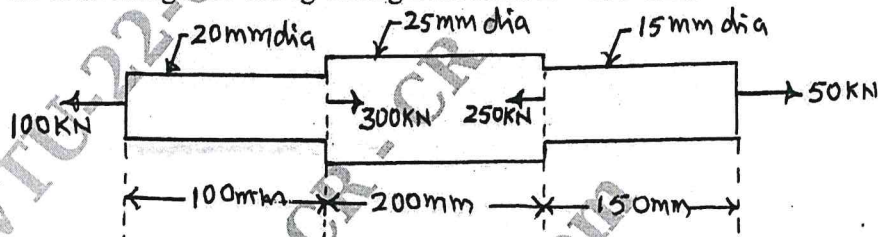Fig.Q1(c)   **(06 Marks)**

OR

2 a. Derive an expression for the deformation of a rectangular tapering bar of uniform thickness subjected to an axial force.   **(10 Marks)**
   b. A steel tube of 80 mm outer diameter and 10 mm thick is filled into a copper tube of 30 mm inner diameter and 10 mm thick. They are connected rigidly at the ends and subjected to an axial compression of 300 kN load. If length of bar is 600 mm, find the stresses in each material. Take E_s = 200 GPa and E_{cu} = 120 GPa.   **(05 Marks)**
   c. A steel rod of 3 cm diameter and 5 m long is connected to two grips and the rod is maintained at temperature of 95°C. Determine the stresses and pull exerted when temperature falls below 30°C if:
      (i) The ends are not yielding
      (ii) The ends yields by 0.12 cm
      Take $E = 2 \times 10^5$ MN/m^2 and $\alpha = 12 \times 10^{-6}$/°C.   **(05 Marks)**

Module-2

3 a. Explain maximum shear stress theory of failure.   **(08 Marks)**
   b. A cast iron pipe 200 mm internal diameter and 50 mm metal thickness carries water under a pressure of 5 N/mm^2. Calculate the maximum and minimum intensities of circumferential stresses and sketch the distribution of circumferential stress intensity and intensity of radial pressure across the cross section.   **(12 Marks)**

OR

4 a. Differentiate between thick and thin cylinders.   **(02 Marks)**
   b. For thin cylinder, derive the equations for circumferential stress and longitudinal stress.   **(08 Marks)**

c. At a certain point in a strained material the stress conditions shown in Fig.Q4(c). Determine:
   (i) The normal and shear stresses on the inclined plane AB.
   (ii) Principal stresses and principal planes.
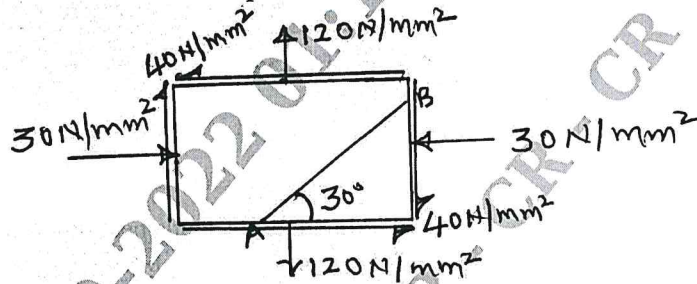   (iii) Maximum shear stresses and their planes.

Fig.Q4(c) **(10 Marks)**

Module-3

5 a. Explain different types of beams and supports. **(06 Marks)**

b. Define: (i) Shear force   (ii) Bending moment   (iii) Point of contra-flexure **(06 Marks)**

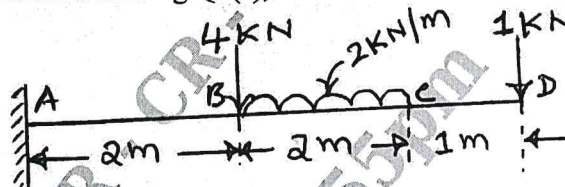c. For the cantilever beam shown in Fig.Q5(c), draw shear force and bending moment diagram.

Fig.Q5(c) **(08 Marks)**

OR

6 a. Derive the relationship between shear force, bending moment and load intensity. **(08 Marks)**

b. Draw the shearforce and bending moment diagram indicating principal values for an overhanging beam shown in Fig.Q6(b). Locate point of contraflexure if any.
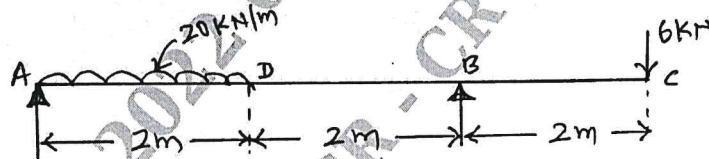

Fig.Q6(b) **(12 Marks)**

Module-4

7 a. Derive bending equation $\dfrac{M}{I} = \dfrac{f}{y} = \dfrac{E}{R}$ with usual notations. **(10 Marks)**

b. A hollow shaft has to transmit 600 KW power at 80 rpm. Torque developed may exceed the mean torque by 40%. Design the suitable section if the working stress is 90 MPa. Take diameter ratio 0.8. What will be the angular twist measured over a length of 2 m? Take C = 84 GPa. **(10 Marks)**

OR

8 a. Derive torsion equation $\dfrac{T}{J} = \dfrac{C\theta}{\ell} = \dfrac{q}{R}$ for a circular shaft subjected to pure torsion. **(10 Marks)**

b. Explain pure bending. **(04 Marks)**

c. Draw shear stress distribution for an I-shaped section of beam shown in Fig.Q8(c). Shear force on the section is 200 kN.
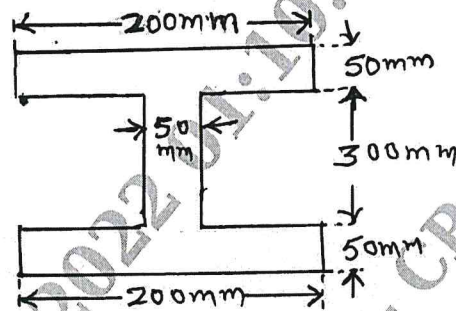

Fig.Q8(c)

(06 Marks)

Module-5

9 a. Derive the deflection equation for a beam in the standard form $EI\dfrac{d^2y}{dx^2} = -M$. **(08 Marks)**

b. Define: (i) Slope   (ii) Deflection   (iii) Elastic curve **(06 Marks)**

c. Find the Euler's crippling load for a hollow cylindrical steel column 40 mm external diameter and 4 mm thick. Consider the length of column 2.3 m and hinged at its both the ends. Also determine the crippling load by Rankines formula using constants 335 N/mm^2 and $a = \dfrac{1}{75000}$. Take E = 200 kN/m^2. **(06 Marks)**

OR

10 a. Derive an expression for Euler's crippling load for both ends hinged column with usual notations. **(08 Marks)**

b. Explain the failure of short column and long column. **(04 Marks)**

c. Derive an expression for the slope and deflection for a simply supported beam carrying UDL over entire span. **(08 Marks)**

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