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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Third Semester, B.E. - Industrial and Production Engineering

Semester End Examination; March - 2021

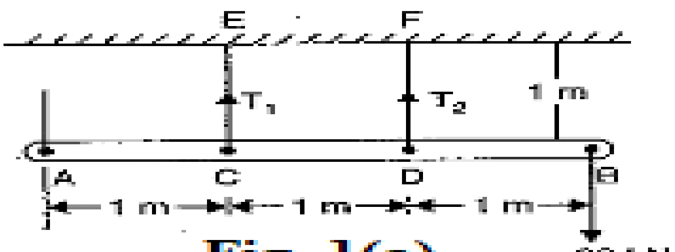
Mechanics of Materials

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:
CO1: Explain the steps involved in casting processes.
CO2: Distinguish between various casting processes.
CO3: Explain special types of welding processes.
CO4: Analyze shear angle using Merchants circle diagram. Explain various types of cutting tool materials.
CO5: Estimate Tool life and Describe Mechanism of machines.

***Note:** **I) PART - A** is compulsory. **Two** marks for each question.*
***II) PART - B**: Answer any **Two** sub questions (from a, b, c) for Maximum of **18 marks** from each unit.*

Q. No.	Questions	Marks	BLs	COs	POs
	I : PART - A	**10**			
I a.	Explain the different types of stresses.	2	L1	CO1	PO1
b.	Explain coefficient of thermal expansion.	2	L1	CO2	PO1
c.	With a neat sketch, explain the different types of loads on beams.	2	L3	CO3	PO1
d.	Mention the assumptions made in pure bending or simple bending.	2	L1	CO4	PO1
e.	Explain the relationship between actual crippling load and crushing load by Euler's theory.	2	L1	CO5	PO1
	II : PART - B	**90**			
	UNIT - I	**18**			
1 a.	A rigid bar *ACDB* is hinged at *A* and supported in a horizontal position by two identical steel wires as shown in Fig. 1(a). A vertical load of 30 kN is applied at *B*. Find the tensile forces T_1 and T_2 induced in these wires by the vertical load.  Fig. 1(a)	9	L3	CO1	PO2
b.	The principal stresses at a point in a bar are 200 N/mm^2 (tensile) and 100 N/mm^2 (compressive). Determine the resultant stress in magnitude and direction on a plane inclined at 600 to the axis of the major principal stress. Also determine the maximum intensity of shear stress in the material at the point.	9	L3	CO1	PO2

Contd... 2

c.	The bar shown in Fig. 1(c) is subjected to a tensile load of 160 kN. If the stress in the middle portion is limited to 150 N/mm^2, determine the diameter of the middle portion. Find also the length of the middle portion if the total elongation of the bar is to be 0.2 mm. Young's modulus = 2.1×10^5 N/mm^2.	9	L3	CO1	PO2

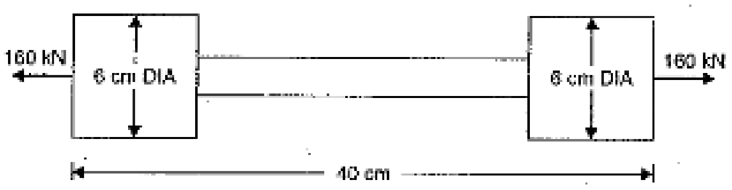


Fig. 1(c)

UNIT - II **18**

2 a.	Three bars made of copper, zinc and aluminum are of equal length and have cross section 500, 750 and 1000 square mm respectively. They are rigidly connected at their ends. If this compound member is subjected to a longitudinal pull of 250 kN, estimate the proportional of the load carried on each rod and the induced stresses. Take the value of *E* for copper = 1.3×10^5 N/mm^2, for Zinc = 1.0×10^5 N/mm^2 and for aluminum = 0.8×10^5 N/mm^2.	9	L3	CO2	PO2
b.	A steel tube of 30 mm external diameter and 25 mm internal diameter encloses a gun metal rod of 20 mm diameter to which it is rigidly joined at each end. The temperature of the whole assembly is raised to 140°C and the nuts on the rod are then screwed lightly home on the ends of the tube. Find the intensity of stress in the rod when the common temperature has fallen to 30°C. The value of *E* for steel and gun metal is 2.1×10^5 N/mm^2 and 1×10^5 N/mm^2 respectively. The linear coefficient for steel and gun metal is 12×10^{-6} /°C and 20×10^{-6} /°C.	9	L3	CO2	PO2
c.	An elemental cube is subjected to tensile stress of 30 N/mm^2 acting on two mutually perpendicular planes and a shear stress of 10 N/mm^2 on these planes. Draw the Mohr's circle of stress and determine the magnitudes and directions of principal stresses and also the greatest shear stress.	9	L3	CO2	PO2

UNIT - III **18**

3 a.	A boiler shell is to be made of 15 mm thick plate having a limiting tensile stress of 120 N/mm^2. If the efficiencies of the longitudinal and circumferential joints are 70% and 30% respectively. Determine, the maximum permissible diameter of the shell for an internal pressure of 2 N/mm^2 and Permissible intensity of internal pressure when the shell diameter is 1.5 m.	10	L3	CO3	PO2

Contd... 3

b. Draw SF and BM diagrams for the over-hanging beam carrying uniformly distributed load of 2 kN/m over the entire length and a point load of 2 kN as shown in Fig. 3(b). Locate the point of contra flexure. — 10 L3 CO3 PO2

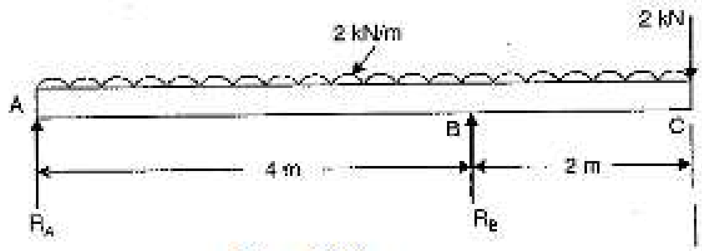


Fig. 3(b)

c. Draw the sheer force and bending moment diagrams for a simply supported beam of length 8 m and carrying a uniformly distributed load of 10 kN/m for a distance of 4 m as shown in the Fig. 3(c). — 8 L3 CO3 PO2

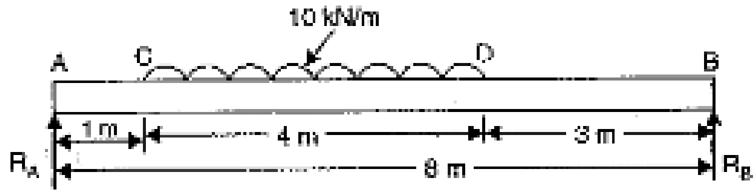


Fig. 3(c)

UNIT - IV — 18

4 a. A cast iron beam is of T-section as shown in Fig. 4(a). The beam is simply supported on a span of 8 m. The beam carries a uniformly distributed load of 1.5 kN/m length on the entire span. Determine the maximum tensile and maximum compressive stresses. — 10 L3 CO PO2

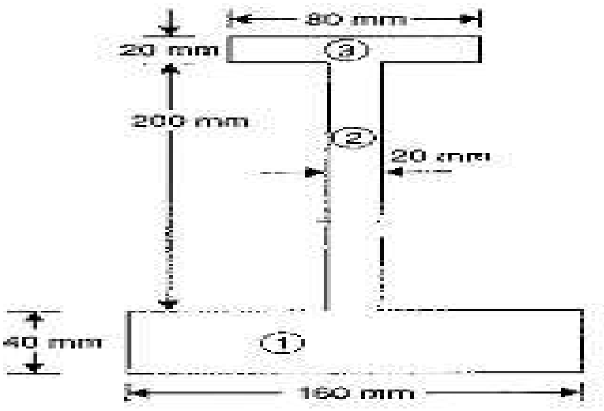


Fig. 4(a)

b. The sheer force acting on a beam at an I-section with unequal flanges is 50 kN. The section is shown in Fig. 4(b). The moment of inertia of the section about N.A is 2.849 * 104. Calculate the shear stress at the N.A and also draw the shear stress distribution over the depth of the section. — 10 L3 CO4 PO2

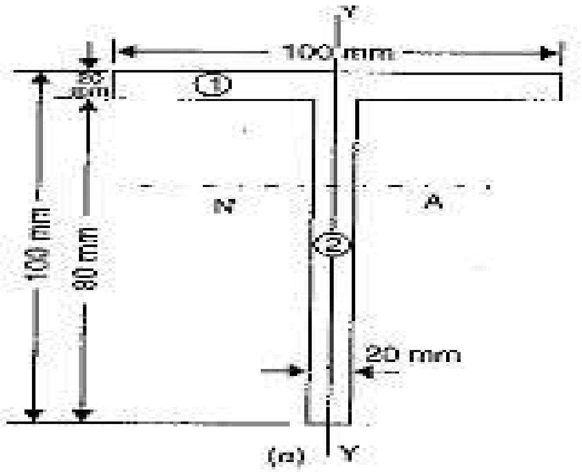


Fig. 4(b)

c. Derive the relation between; i) Bending Stress and Radius of Curvature ii) Bending Moment and Radius of Curvature	8	L2	CO4	PO1

UNIT - V **18**

5 a. A simply supported beam of span *L* is subjected to equal loads W/2 at each of 1/3rd span points. Find the expressions for deflection under the load and at mid span.	8	L3	CO5	PO2
b. A shaft is required to transmit 245 kW power at 240 rpm. The maximum torque may be 1.5 times the mean torque. The shear stress in the shaft should not exceed 40 N/mm^2 and the twist 10 per metre length. Determine the diameter required if, i) The shaft is solid ii) The shaft is hollow with external diameter twice the internal diameter. Take modulus of rigidity = 80 kN/mm^2.	10	L3	CO5	PO2
c. Determine the crippling load for a T-section of dimensions 10 cm × 10 cm × 2 cm and of length 5 m when it is used as strut with both of its ends hinged as shown in Fig. 5(c). Take Young's modulus E = 2.0×10^5 N/mm^2.	10	L2	CO5	PO1

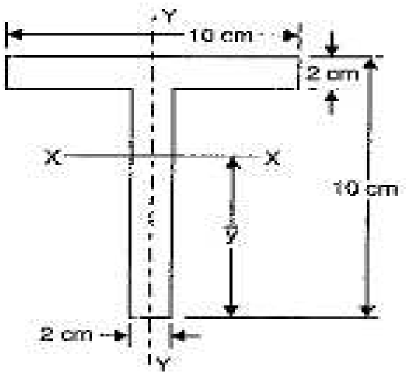


Fig. 5(c)

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