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

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Automobile Engineering

Semester End Examination; Sep. / Oct. - 2023

Mechanics of Materials

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1: Apply the concepts of normal stresses, strain, shear stress, bending stress torsional stress and buckling stress in mechanical components.

CO2: Apply the fundamentals of thermal stress and compound stresses in bars of uniform and compound section.

CO3: Analyse the uniform, stepped, compound bars, beams for different cross section and columns.

CO4: Analyse the beams for deflection using Macaulay's method.

***Note**: I) **PART - A** is compulsory. **Two** marks for each question.*

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

Q. No.	Questions	Marks	BLs	COs	POs
	I : PART - A	**10**			
1 a.	Draw stress-strain curve for tension test on mild steel.	2	L1	CO4	PO1
b.	Discuss the elastic constants.	2	L1	CO2	PO1
c.	Define point of Contraflexure.	2	L1	CO3	PO1
d.	Write the assumptions made in the theory of simple bending.	2	L1	CO4	PO1
e.	Mention how the failure of column takes place.	2	L1	CO5	PO1
	II : PART - B	**90**			
	UNIT - I	**18**			
2 a.	Derive an expression for change in length of uniformly tapering circular rod.	6	L2	CO1	PO2
b.	A tensile load of 40 kN is acting on a rod diameter 40 mm and of length 4 m. A bore of diameter 20 mm is made centrally on the rod. To what length the rod should be bored so that total extension will increase 30% under the same tensile load. Take $E = 2 \times 10^5$ N/mm$^{2.}$	12	L3	CO1	PO3
c.	A bar of 30 mm diameter is subjected to a pull of 60 kN. The measured extension on gauge length of 200 mm is 0.1 mm and change in diameter is 0.004 mm. Compute Young's modulus, Poisson's ratio and Bulk modulus.	12	L3	CO1	PO3
	UNIT - II	**18**			
3 a.	Two brass rods and one steel rod together support a load as shown in Fig. 3(a). If the stresses in brass and steel are not to exceed 60 N/mm^2 and 120 N/mm^2, find the safe load that can be supported. Take E for steel as 2×10^5 N/mm^2 and for brass as 1×10^5 N/mm^2.	9	L3	CO2	PO3

Contd…2

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 140ºC and the nuts on the rod are then screwed lightly home on the ends of the tube. Find the intensity of steel in the rod when the common temperature has fallen to 30ºC. The value of E for steel and gum metal is 2.1 x 10^5 N/mm^2 and 1 x 10^5 N/mm^2 respectively. The linear co-efficient of expansion for steel and gum metal is 12 x 10^{-6} per ºC and 20 x 10^{-6} per ºC respectively.	9	L3	CO2	PO3
c.	A plane element is subjected to stresses as shown in Fig. 3(c). Determine principal stresses, maximum shear stress and their planes. Sketch the planes determined.	9	L3	CO2	PO3
	UNIT - III	**18**			
4 a.	Draw the SFD and BMD for the simply supported beam shown in Fig. 4 (a).	9	L3	CO3	PO3
b.	Draw the shear force and bending moment diagrams for the over-hanging beam of length 6 m carrying UDL of 2 kN/m over the entire length. The beam is simply supported for a distance of 4 m.	9	L3	CO3	PO3
c.	Draw the Shear force and bending moment diagrams for the cantilever beam shown in Fig. 4(c).	9	L3	CO3	PO3
	UNIT - IV	**18**			
5 a.	Explain theory of simple or pure bending.	5	L2	CO4	PO2
b.	A cast iron beam is of I-section as shown in Fig. 5(b). The beam is simply supported on a span of 5 meter. If the tensile stress is not to exceed 20 N.mm^2, find the safe uniformly load which the beam can carry. Find also the maximum compressive stress.	13	L3	CO4	PO3
c.	A beam of length 6 m is simply supported at its ends and carries two point loads of 48 kN and 40 kN at a distance of 1 m and 3 m respectively from the left support. Find, deflection under each load, maximum deflection and the point at which maximum deflection and the point at which maximum deflection occurs. Take E = 2 x 10^5 N/mm^2 and I= 85 x 10^6 mm^4.	13	L2	CO4	PO3
	UNIT - V	**18**			
6 a.	Determine the diameter of a solid steel shaft which will transmit 90 kW at 160 rpm. Also determine the length of the shaft if the twist must not exceed 1º over the entire length. The maximum shear stress is limited to 60 N/mm^2. Take the value of modulus of rigidity as 8 x 10^4 N/mm^2 fixed. Take Young's modulus for the joint as 2.1 x 10^5 N/mm^2.	9	L3	CO5	PO3

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b.	Determine the Euler's crippling load for an I-section joint 40 cm × 20 cm × 1 cm long, which is used as a strut with both ends fixed. Take Young's modulus for the joint as 2.1×10^5 N/mm^2.	9	L3	CO5	PO3
c.	Determine the crippling load for a T-section of dimension 100 mm x 100 mm x 20 mm and of length 5 m when it is used as a strut with both of its ends hinged. Take Young's modulus as 2.1 x 10^5 N/mm^2.	9	L3	CO5	PO3

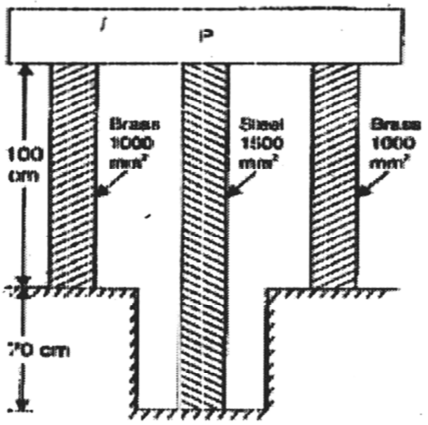

Fig. 3 (a)

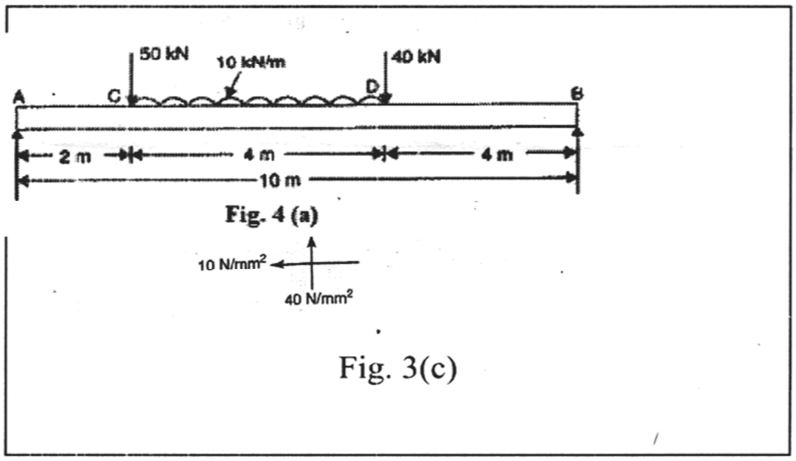

Fig. 4 (a)

Fig. 3(c)

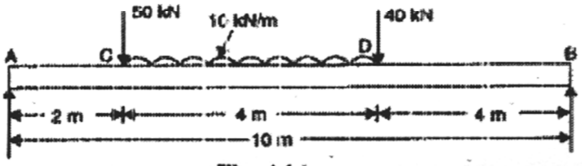

Fig. 4 (a)

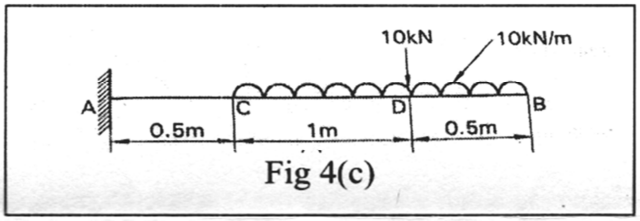

Fig 4(c)

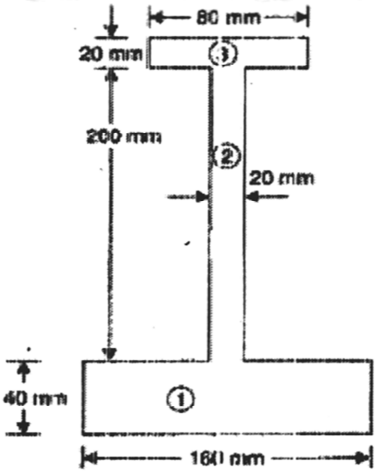

Fig. 5 (b)

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