U.S.N | | | | | | | | | | |

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

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester B.E. - Mechanical 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.	Define stress and mention unit of stress.	2	L1	CO1	PO1
b.	Define compounds bar.	2	L1	CO2	PO1
c.	Define point of contra flexure.	2	L1	CO2	PO1
d.	Mention any two assumptions in simple bending.	2	L1	CO1	PO1
e.	Define torsion and write down torsion equation.	2	L1	CO1	PO1
	II : PART - B	**90**			
	UNIT - I	**18**			
2 a.	A bar of uniform thickness 't' tapers uniformly from a width of b_1 at one end to b_2 at other end in a length 'L'. Find the expression for the change in length of the bar when subjected to an axial force P.	9	L2	CO1	PO1
b.	A specimen of steel 25 mm diameter with a gauge length of 200 mm is tested to destruction. It has an extension of 0.16 mm under a load of 80 kN and the load at elastic limit is 160 kN. The maximum load is 180 kN. The total extension at fracture is 56 mm and diameter at neck is 18 mm. Find; i) The stress at elastic limit ii) Young's Modulus iii) Percentage elongation iv) Percentage reduction in area	9	L3	CO1	PO1
c.	A bar of 800 mm length is attached rigidly at A and B as shown in Fig. 2(c). Forces of 30 kN and 60 kN act as shown on the bar. If E = 200 MPa, determine the reactions at the two ends. If the bar diameter is 25 mm, find the stresses.	9	L3	CO3	PO2

Contd.....2

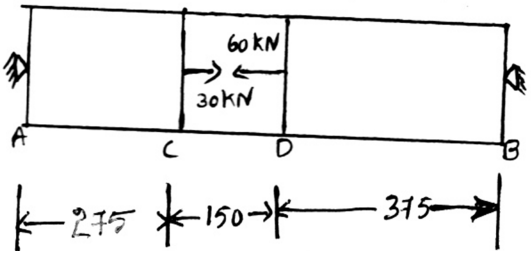

Fig. 2(c)

UNIT - II **18**

3 a. A compound bar consists of a circular rod of Steel of diameter 20 mm rigidly fitted into a Copper tube of internal diameter 20 mm and thickness 5 mm as shown in Fig. 3 (a). If the bar is subjected to a load of 100 kN, find the stresses developed in the two materials.

Take $E_s = 2\times10^5$ N/mm^2 and $E_c = 1.2\times10^5$ N/mm^2. 9 L3 CO3 PO2

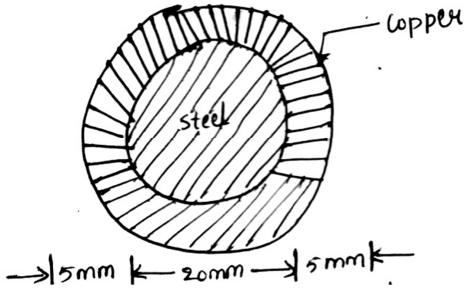

Fig. 3(a)

b. A composite bar is rigidly fitted at the supports A and B as shown in Fig. 3(b). Determine the reactions at the supports when temperature rises by 20° C. Take $E_a = 70$ GN/m^2, $E_s = 200$ GN/m^2, $\alpha_a = 11\times10^{-6}$/° C and $\alpha_s = 12\times10^{-6}$/° C. 9 L3 CO3 PO2

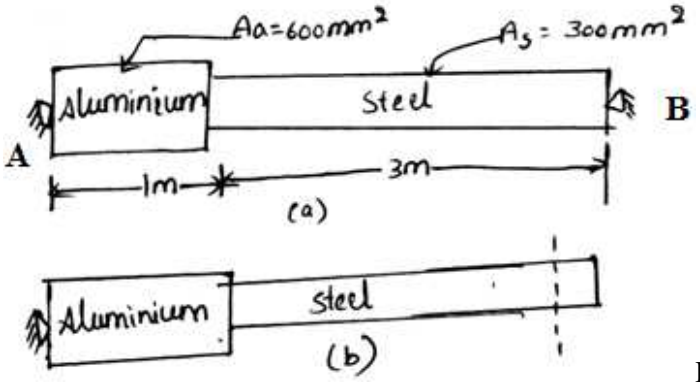

Fig. 3 (b)

c. The state of stress at a point in a strained material is as shown in Fig. 3(c) determine; 9 L3 CO3 PO3

i) The direction of the principal planes

ii) The magnitude of principal stresses

iii) The magnitude of the maximum shear stress and its direction.

Use analytical method

Contd 3

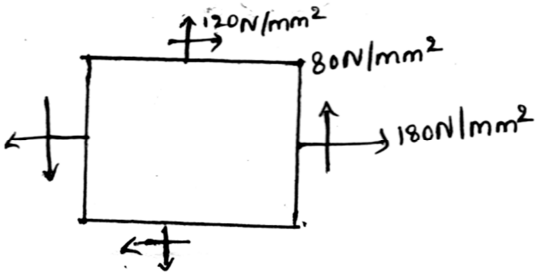

Fig. 3 (c)

UNIT - III **18**

4 a.	With neat sketch, explain types of beams, supports, and loads.	9	L2	CO1	PO1
b.	Draw the shear force and bending moment diagrams for the cantilever beam shown in Fig. 4(b).	9	L3	CO3	PO2

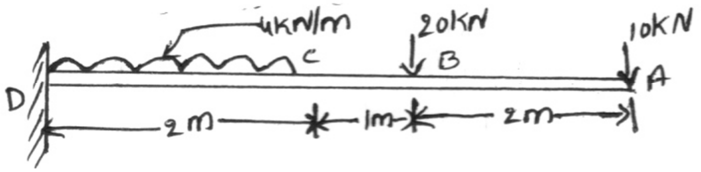

Fig. 4(b)

c.	A simply supported beam AB of 6 m span is loaded as shown in Fig. 4(c). Draw the shear force and bending moment diagrams.	9	L3	CO3	PO2

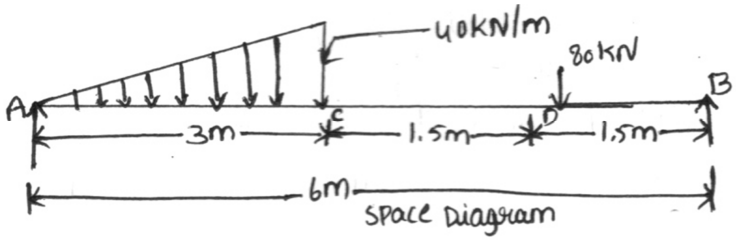

Fig. 4(c)

UNIT - IV **18**

5 a.	Derive the relationship between moment and radius of curvature.	9	L2	CO4	PO2
b.	A circular pipe of external diameter 70 mm and thickness 8 mm is used as a simply supported beam over an effective span 2.5 m. Find the maximum concentrated load that can be applied at the center of the span if permissible stress in tube is 150 N/mm^2.	9	L2	CO4	PO2
c.	Derive differential equation for defection with assumptions.	9	L2	CO4	PO2

UNIT - V **18**

6 a.	Derive the torsional equation and write the assumptions in the theory of pure torsion.	9	L2	CO1	PO1
b.	Determine the diameter of solid shaft which will transmit 440 kW at 280 r.p.m. The angle of twist must not exceed one degree per meter length and the maximum torsional shear stress is to be limited to 40 N/mm^2. Assume G = 84 kN/mm^2.	9	L3	CO1,3	PO1,2
c.	Derive the Euler's equation for critical load in a column with both ends fixed.	9	L2	CO1,3	PO1,2