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

(An Autonomous Institution affiliated to VTU, Belagavi)

Third Semester, B.E. - Automobile Engineering

Semester End Examination; March - 2021

Mechanics of Material

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1: Classify different types of stresses, strain and deformations induced in the mechanical components due to external loads.

CO2: Determine stresses in composite bars, thermal stresses and principal stresses in simple 2D elements.

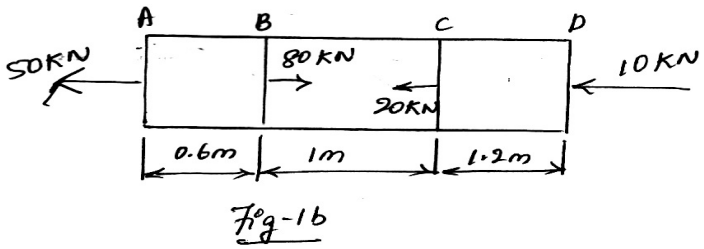
CO3: Draw Shear Force Diagrams and Bending Moment Diagrams for different types of loads and support conditions.

CO4: Compute and analyze bending and shear stresses and deflections induced in beams.

CO5: Determine stresses in thin and thick cylinders, tensional stresses, and Analyze buckling phenomenon in columns.

***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.	Define Hook's law.	2	L1	CO1	P1
	b.	Define the terms; i) Principal plane and ii) Principal stress	2	L1	CO2	P1
	c.	Differentiate between a cantilever and simply supported beam.	2	L1	CO3	P1
	d.	List the assumption made in theory of simple bending.	2	L1	CO4	P1
	e.	Differentiate between a thick and thin cylinder.	2	L1	CO5	P1
		II : PART - B	**90**			
		UNIT - I	**18**			
1	a.	Derive the equation of relationship between Young's modules and rigidity modules.	9	L2	CO1	P2
	b.	A brass bar having cross-sectional area of 1000 mm^2 is subjected to axial forces as shown in Fig. 1(b). Find the total elongation of the bar. Take E = 1.05 x 10^5 N/mm^2.  Fig-1b	9	L2	CO1	P3
	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. Calculate; i) Young's modulus ii) Poisson's ratio iii) Bulk modulus	9	L3	CO1	P2

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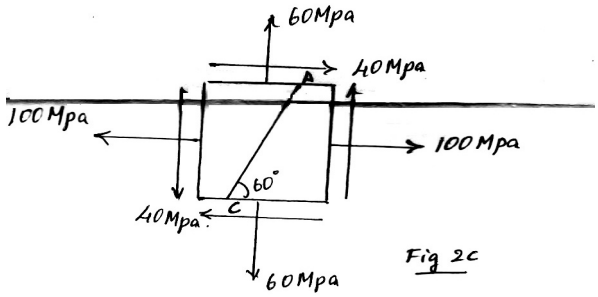
UNIT - II **18**

2 a.	A steel tube of 30 mm external diameter and 20 mm internal diameter encloses a copper rod of 15 mm diameter to which it is rigidly joined at each end. If at a temperature of 10°C there is no longitudinal stress. Calculate the stresses in the rod and tube, when the temperature is raised to 200°C. Take E for steel and copper as 2.1×10^5 N/mm^2 and 1×10^5 N/mm^2 respectively. The value of coefficient of linear expansion for steel and copper is given as 11×10^{-6} /°C and 18×10^{-6} /°C respectively.	9	L3	CO2	P2
b.	Two planes AB and BC which are at right angles carry shear stress of intensity 17.5 N/mm^2 while these planes also carry a tensile stress of 70 N/mm^2 and a compressive stress of 35 N/mm^2 respectively. Determine the principal planes and the principal stresses. Also the maximum shear stress and the planes on which it acts.	9	L3	CO2	P3
c.	In an elastic material, the stresses acting on an elementary block are shown in Fig. 2(c).  Fig 2c	9	L3	CO2	P2

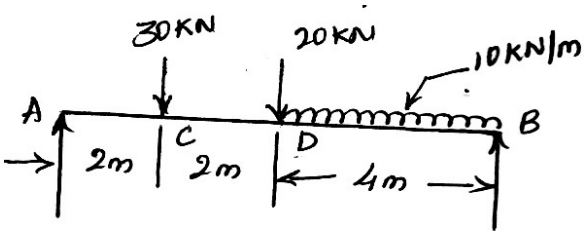
Compute;

i) Principal stresses and their planes

ii) Maximum shear stress and its plane

iii) Normal, tangential shear and resultant stresses on plane AC

UNIT - III **18**

3 a.	A cantilever of length 2.0 m carries a uniformly distributed load of 2 kN/m length over the whole length and a point load of 3 kN at the free end. Draw the SF and BM diagram for the cantilever.	9	L3	CO3	P3
b.	The simply supported beam shown in Fig. 3(b), carries two concentrated loads and a uniformly distributed load. Draw the SFD and the BMD.  Fig 3b	9	L3	CO3	P3

Contd…3

c. A simply supported beam AB of 6 m span is loaded as shown in Fig. 3(c). Draw SFD and BMD diagram.

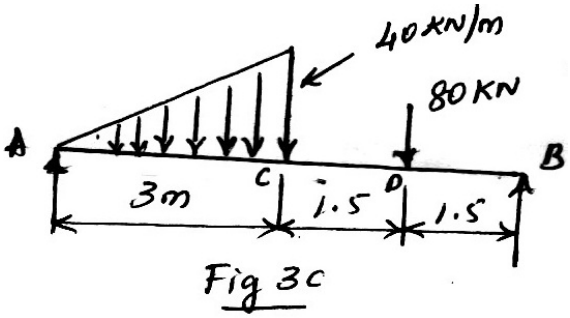


Fig 3c

9 L3 CO3 P3

UNIT - IV **18**

4 a. List the assumption made in simple theory of bending and find the relationship between bending stresses and radius of curvature. 9 L2 CO4 P2

b. A symmetric I-section has flanges of size 180 mm × 10 mm and its overall depth is 500 mm thickness of web is 8 mm. It is strengthened with a plate of size 240 mm × 12 mm on compression side. Find the moment of resistance of the section, if permissible stress is 150 N/ mm^2. 9 L3 CO4 P3

c. A simply supported beam of 6 m span is subjected to a concentrated load of 18 kN at 4 m from left support. Calculate;

i) The position and the value of maximum deflection
ii) Slope at mid span
iii) Deflection at the load point

9 L4 CO4 P3

UNIT - V **18**

5 a. A thin cylindrical shell 2 m long has 200 mm diameter and thickness of metal 10 mm. It is filled completely with a fluid at atmospheric pressure. If an additional 25000 mm^3 fluid is pumped in, find the pressure developed and hoop stress developed. Take $E = 2 \times 10^5$ N/mm^2 and $\mu = 0.3$. 9 L3 CO5 P3

b. A thick cylindrical pipe outside diameter 300 mm and internal diameter 200 mm is subjected to an internal fluid pressure of 14 N/mm^2. Determine the maximum hoop stress developed in the C/S. 9 L3 CO5 P3

c. Determine the diameter of solid shaft which will transmit 440 kW at 280 rpm. 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 CO5 P3

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