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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 / April - 2022
Mechanics of Materials

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.

<u>***Note:***</u> *I) PART - A is compulsory. **Two** marks for each question.*
    *II) PART - B: Answer any <u>**Two**</u> 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: i) Young's Modulus ii) Poison's Ratio	2	L1	CO1	PO1
b.	What are thermal stresses?	2	L2	CO2	PO1
c.	What is point of contra flexure?	2	L3	CO3	PO1
d.	List the assumptions made in theory of Pure fusion.	2	L4	CO4	PO1
e.	What is circumferential and longitudinal stress?	2	L5	CO5	PO1
	II : PART - B	**90**			
	UNIT - I	**18**			
1 a.	Explain with neat sketch, the stress-strain curve for a mild steel specimen.	9	L1	CO1	PO1
b.	A hallow steel column of external diameter 250 mm has to support an axial load of 2400 kN. Find the internal diameter of the column, when the safe stress shall not exceed 120 N/mm^2.	9	L2	CO1	PO1
c.	A bar of 20 mm diameter is subjected to a pull of 40 kN. The measured extension on gauge length of 200 mm is 0.13mm and the change in diameter is 0.004 mm, calculate three moduli.	9	L2	CO1	PO2
	UNIT - II	**18**			
2 a.	A 15 mm diameter steel rod passes centrally through a copper tube 50 mm external diameter and 40 mm internal diameter. The tube is enclosed at each end by rigid plates on negligible thickness. The nuts are tightened on both the plates of the rod. If the temperature of the assembly is raised by 60°C, calculate the stresses developed in copper and steel. Take; t_s = 210 GPa, E_c = 105 GPa, α_s = 12×10^{-6}/°C, α_c = 17.5×10^{-6}/°C.	9	L2	CO2	PO1

b. An RCC is 300 mm x 300 mm in section the column is provided with 4 bars of 2 0mm diameter. The column carries a load of 160 kN. Find the stresses in concrete and steel rod.

9 L3 CO2 PO1

c. An element is subjected to biaxial stress and accompanied with the shear stress as shown in Fig (1). Determine the principal stresses and their directions and the direction of the plane on which they occur.
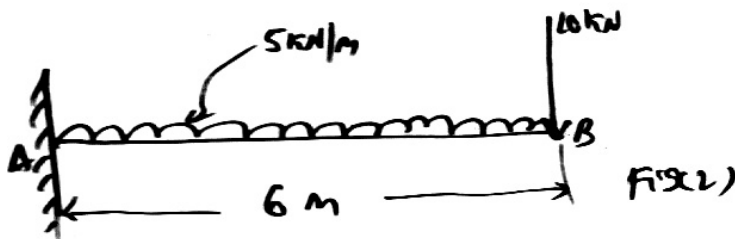

Fig(1)
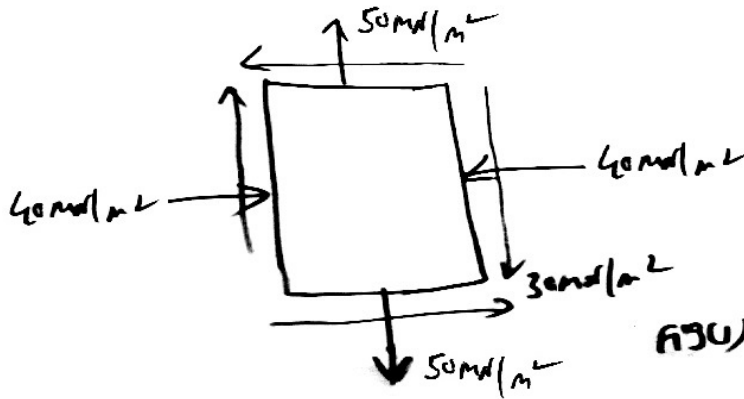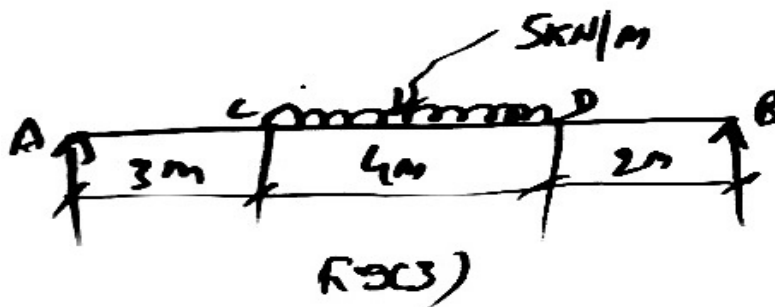
9 L3 CO2 PO2

UNIT - III 18

3 a. Draw SFD and BMD for a cantilever subjected to UDL and a point load as shown in Fig (2).

Fig(2)

13 L3 CO3 PO2

b. Construct SFD and BMD for a simply supported beam carrying UDL as shown in Fig (3).

Fig(3)

13 L3 CO3 PO2

c. Explain with sketches, different types of beam supports. 5 L2 CO3 PO1

UNIT - IV 18

4 a. A simply supported beam 100 x 200 mm carries a central concentrated load *W*. The permissible stresses in bending and shear are 15 N/mm^2 and 1.2 N/mm^2 respectively. Determine the safe load '*W*' of the span, if the span of the beam is 3 m.

9 L3 CO4 PO2

b. A rolled steel beam having a span of 6 m carries a point load of 40 kN at 4 m from the left support. Find the deflection under the load and the position and the amount of maximum deflection I_{xx} for the section is 7.33 x 10^7 mm⁴, E = 200 kN/mm² | 9 | L3 | CO4 | PO2

c. Derive the bending equation $\dfrac{M}{I} = \dfrac{f}{y} = \dfrac{E}{R}$ with usual notations. | 9 | L3 | CO4 | PO2

UNIT - V | **18**

5 a. A hallow circular shaft has to transmit 60 kW at 210 rpm such that the maximum shear stress does not exceed 60 MN/m². If the ratio of the internal to external diameter is equal to ¾ and the value of rigidity modulus is 84 GPa. Find the dimensions of the shaft and the angle of twist in a length of 3 m. | 9 | L3 | CO5 | PO2

b. A bar of length 5 m when used as a simply supported beam and subjected to a UDL of 30 kN/m over the whole span, deflects 2 cm at the centre. Determine the crippling loads when it is used as a column with the following conditions:
 i) Both the ends pin jointed
 ii) One end is fixed and the other end is hinged
 iii) Both the ends are fixed | 9 | L3 | CO5 | PO2

c. A thick cylindrical pipe of outside diameter 300 mm and thickness of metal 60 mm is subjected to an internal fluid pressure of 40 MPa. Determine the maximum and minimum intensifies of hoop stress and radial stresses induced in the pipe section. Plot the hoop stress and radial stresses induced. | 9 | L3 | CO5 | PO2

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