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

(An Autonomous Institution affiliated to VTU, Belagavi)

Third Semester, B.E. – Civil Engineering

Semester End Examination; March/April - 2022

Strength of Materials

Time: 3 hrs *Max. Marks: 100*

Course Outcome

The Students will be able to:

CO1: Apply the knowledge of basic science and mathematics to understand the concepts of stress at a point, strain at a point, and the stress-strain relationships for linear, elastic, homogeneous, isotropic materials.

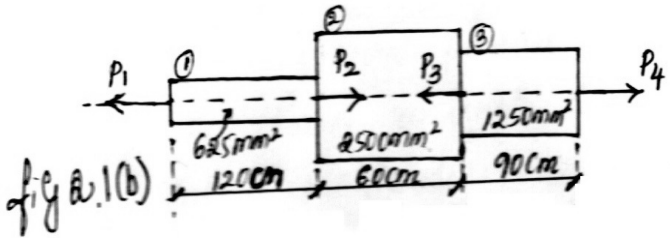
Co2: Analyse structural members subjected to tension, compression, torsion, bending, combined stresses and internal pressure using the fundamental concepts of stress, strain, elastic behavior of materials and sketch BMD and SFD.

Co3: Compute the stresses and strains in members subjected to tension, compression, torsion, bending, combined stresses and internal pressure.

Co4: Apply the knowledge of strength of materials in future to work effectively either as an individual or as a team member to satisfy the changing professional and societal needs.

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.	Draw the stress-strain curve for mild steel under tension with salient points.	2	L1	CO1	PO1,2
	b.	Define principal stresses and their planes.	2	L1	CO2	PO1,2
	c.	Mention the relationships between Bending moment, shear force and intensity of loading with usual notations.	2	L1	CO3	PO1,2
	d.	Define section modulus.	2	L1	CO4	PO1,2
	e.	Write the relationship between twisting moment, shear force and the intensity of loading.	2	L1	CO1	PO1,2
		II : PART - B	**90**			
		UNIT - I	**18**			
1	a.	Derive the expression for the deformation for rectangular bar of uniformly varying thickness.	9	L2	CO1	PO1,2
	b.	A member ABCD is subjected to point loads P_1, P_2, P_3 and P_4 as shown in Fig. 1(b).  fig Q.1(b)	9	L3	CO1	PO1,2

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Calculate the force P_2 necessary for equilibrium, if P_1 = 45 kN, P_3 = 450 kN and P_4 = 130 kN. Determine the total elongation of the member assuming the modulus of elasticity to be 2.1×10^5 N/mm^2.

c. A concrete column of 400 mm × 400 mm carrying an axial load of 270 kN is reinforced with 6 numbers of 12 mm dia bars located at each corners. Determine the stress is steel and concrete. Take $E_S = 2.1\times10^5$ N/mm^2, $E_C = 1.5\times10^4$ N/mm^2 and the length of column is 300 mm. 9 L3 CO1 PO1,2

UNIT - II **18**

2 a. Derive an expression for maximum and minimum principal stresses in a 2-dimensional stress system. 9 L2 CO2 PO1,2

b. With usual notations prove Lame's equation for thick cylinders. 9 L2 CO2 PO1,2

c. A thin cylinder shell 1 m in dia and 3 m long has a metal thickness of 10 mm. If it is subjected to an internal pressure of 3 N/mm^2. Determine the changes in length, diameter and volume. Take E = 210GPa and $\mu = 0.3$ 9 L3 CO2 PO1,2

UNIT - III **18**

3 a. Analyze a cantilever beam subjected to uniformly distributed load of w/unit length over entire span of length 'L'. Also draw SFD and BMD. 9 L3 CO3 PO1,2

b. Draw the shear force and bending moment diagram for the beam shown in Fig. Q3(b)

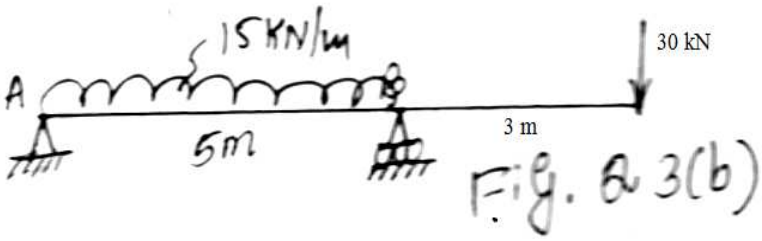

Fig. Q 3(b) 9 L3 CO3 PO1,2

c. Draw BMD and SFD for the beam shown in Fig. 3(c) Also find the point of contra flexure.

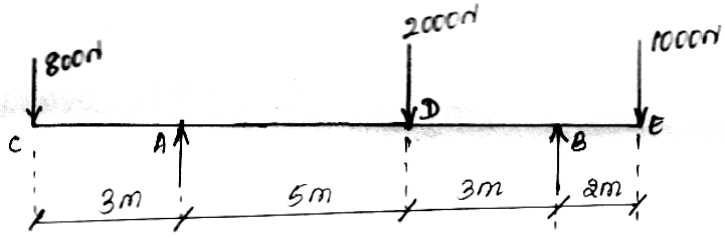

Fig. Q 3(c) 9 L3 CO3 PO1,2

UNIT - IV **18**

4 a. Derive the equation for pure bending with usual notations. 9 L3 CO4 PO1,2

Contd... 3

b. A beam of I-section shown in Fig. Q4(b) has overall depth of 250 mm. The flanges are 125 mm wide and 12.5 mm thick. The web is 5 mm thick. The beam rests fully on support 6 m apart. Find the maximum load that may be applied at a point 1.5 m from left support, producing a maximum flange stress not greater than 80 MN/m^2. 9 L1 CO4 PO1,2

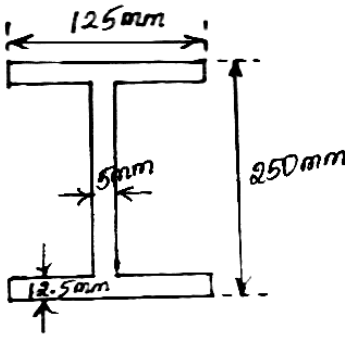

Fig. Q. 4(b)

c. Two Beams are simply supported over the same span and have the same flexural strength. Compare the weights of these two beams, if one of them is solid and the other is hollow section with internal diameter half of the external diameter. 9 L4 CO4 PO1,2

UNIT - V **18**

5 a. Derive Euler's Buckling load for one end fixed and other end free. 9 L2 CO5 PO1,2

b. A hollow cast iron column whose outside diameter is 200 mm, has a thickness of 20mm and is 4.5 m long and is fixed at both ends. Evaluate Rankine's crippling load using f_c = 550N/mm^2. Take Rankine's constant $= \frac{1}{1600}$ 9 L2 CO5 PO1,2

c. A hollow circular shaft with a 250 mm external diameter and thickness of 25 mm transmits power at 180 rpm. The angle of twist over a length of 3 m was found to be 0.72º. Calculate the power transmitted on the maximum shear stress induced in the section. Take modulus of rigidity C = 84GN/m^2 9 L2 CO5 PO1,2

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