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

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 - 2021

Strength of Materials

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

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**			
1 a.	Define Hooke's law.	2	L1	CO1	PO1,2
b.	Define principal stresses.	2	L1	CO2	PO1,2
c.	What do you mean by sagging bending moment and hogging bending moment?	2	L1	CO3	PO1,2
d.	Define bending stresses.	2	L1	CO4	PO1,2
e.	Distinguish between long and short columns.	2	L1	CO1	PO1,2
	II: PART - B	**90**			
	UNIT - I	**18**			
1 a.	Derive the expression for the deformation for a bar of uniformly tapering rectangular bar subjected to an axial force.	9	L1	CO1	PO1,2
b.	Different portions of a stepped bar are subjected to forces as shown in Fig. 1(b). Determine the stress induced and the net deformation in the bar Take E = 200 GPa.	9	L3	CO1	PO1,2

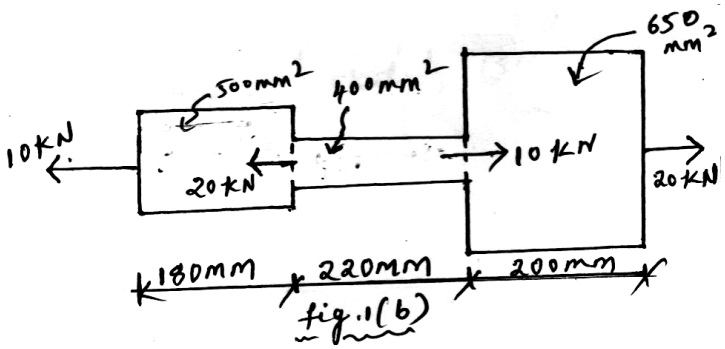

fig.1(b)

Contd… 2

c. A concrete column 300 mm × 300 mm carrying an axial load of 250 kN is reinforced with 4 numbers of 16 mm dia rods located at each corners. Determine the stress in steel and concrete. Also, determine the amount by which the column shortens. The length of the column is 300 mm. Take $E_S = 2.1 \times 10^5$ N/mm^2 and $E_C = 1.5 \times 10^4$ N/mm^2. — 9 L3 CO1 PO3

UNIT - II **18**

2 a. Derive expressions for normal and tangential stresses on a given plane in a 2D stress system. — 9 L2 CO2 PO1,2

b. Derive the expressions for circumferential and longitudinal stresses in case of thin cylinders. — 9 L2 CO2 PO1,2

c. Determine the maximum and minimum Hoop stress across the section of a pipe of 400 mm internal dia and 100 mm thick when the pipe contains a fluid at a pressure of 8 N/mm^2. Also sketch the radial pressure distribution and Hoop stress distribution across the section. — 9 L2 CO2 PO1,2

UNIT - III **18**

3 a. Analyze the simply supported beam of span '*L*' subjected to uniformly distributed load of *w*/unit length over the entire span. Sketch BMD and SFD. — 9 L3 CO3 PO1,2

b. Draw shear force and bending moment diagram for the beam shown in Fig 3(b).

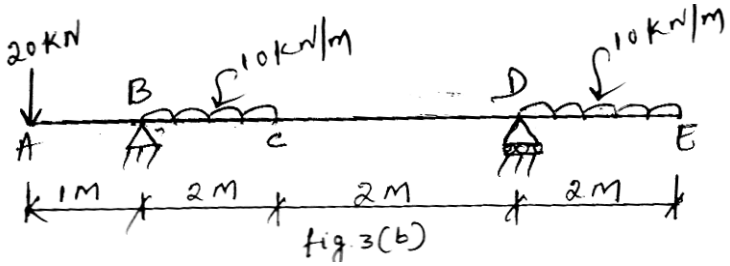

fig 3(b)

9 L3 CO3 PO1,2

c. Draw BMD and SFD for the beam shown in Fig. 3(c). Find the point of contra flexure if any.

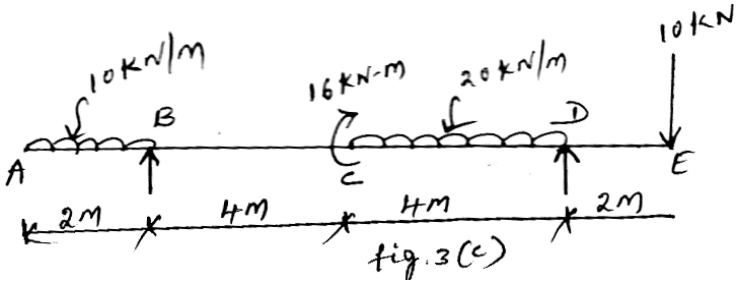

fig 3(c)

9 L3 CO3 PO1,2

UNIT - IV **18**

4 a. Derive the equation of pure bending, $\frac{M}{I} = \frac{f}{y} = \frac{E}{R}$ with usual notations. State the assumptions. — 9 L3 CO4 PO1,2

Contd… 3

b. A circular pipe of internal diameter 70 mm and thickness 8 mm is used as a simply supported beam over an effective span of 2.5 m. Find the maximum concentrated load that can be applied at the centre of the span, if the permissible stress in the tube is 150 N/mm^2. — 9 L1 CO4 PO1,2

c. The Shear force acting on a section of a beam is 50 kN. The section of the beam is of *T* shaped with dimensions as shown in Fig. 4(c). The moment of Inertia about the horizontal neutral axis is 314.22×10^4 mm^4. Sketch the shear stress distribution for the section. — 9 L4 CO4 PO1,2

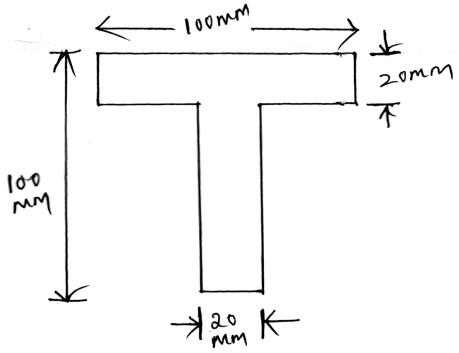

fig. 4(c)

UNIT - V **18**

5 a. Derive Euler's Buckling load for both ends hinged column. — 9 L3 CO5 PO1,2

b. Find the maximum stress in propeller shaft 400 mm external dia and 200 mm internal dia when subjected to a twisting moment of 4650 N-m. If the modulus of rigidity is 82 GPa. How much is the twist in a length = 20 times the dia? — 9 L2 CO5 PO1,2

c. A 1.5 m long C.I. column has a circular cross section of a 50 mm diameter. One end of the column is fixed in direction and position and the other is free. Taking *fos* = 3. Calculate the safe load using; — 9 L2 CO5 PO1,2

i) Rankine-Grashoff formula. Take yield stress = 560 MN/m^2 and $\alpha = \frac{1}{1600}$

ii) Euler's formula : E = 120 GN/m^2

* * *