Basavarajeswari Group of Institutions

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

USN											Course Code	2	1	M	E	3	4

Third Semester B.E. Degree Examinations, April/May 2023

MECHANICS OF MATERIALS

Duration: 3 hrs **Max. Marks: 100**

Note: ***1. Answer any FIVE full questions, choosing ONE full question from each module.***
2. Missing data, if any, may be suitably assumed

Q. No		Question	Marks	(RBTL:CO:PI)
		MODULE – 1		
1.	**a.**	Define (i) Factor of safety (ii) Young's Modulus	**04**	(2 :1 : 1.6.1)
	b.	Define Stress? List and explain the types of stress.	**06**	(2 :1 : 1.6.1)
	c.	Determine the stress in different segments of a circular bar as shown in Fig. Q1(c). Compute the total elongation of the bar if E = 200 GPa.	**10**	(3 :1 : 1.7.1)

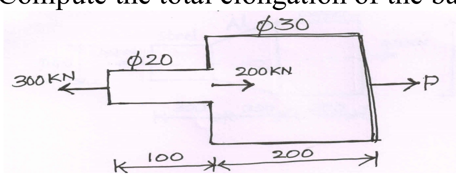

Fig. Q 1(c)

OR

Q. No		Question	Marks	(RBTL:CO:PI)
2.	**a.**	Derive an expression for Elongation of tapering bars of circular in cross-section.	**10**	(2 :1 : 1.6.1)
	b.	A metallic block 300 mm × 100 mm × 40 mm is subjected to a force of 5kN (tensile), 6kN (tensile) and 4kN (tensile) along x, y and z directions respectively. Determine the change in the volume of block. Take E = 2×10^5 N/mm^2 and Poisson's ratio = 0.25.	**10**	(3 :1 : 1.7.1)
		MODULE – 2		
3.	**a.**	Define and explain principal stress and principal strain.	**08**	(2 :2 : 1.6.1)
	b.	For the system shown in Fig. Q3(b), determine (i) Normal and tangential stress (ii) Magnitude and direction of resultant stress (iii) Maximum shear stress	**12**	(3 :2 : 1.7.1)

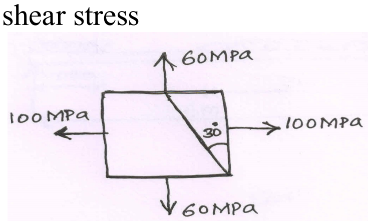

Fig. Q 3(b)

OR

Q. No		Question	Marks	(RBTL:CO:PI)
4.	**a.**	Derive the expressions for change in diameter, length and volumetric strain of thin cylinder due to the effect of internal pressure.	**10**	(2 :2 : 1.6.1)
	b.	Determine the maximum and minimum hoop stress across the section of a pipe of 400 mm internal diameter and 100 mm thick, when the pipe contains a fluid at a pressure 8 N/m^2. Also sketch the radial pressure distribution and hoop stress distribution across the section.	**10**	(3 :2 : 1.7.1)

Note: (**RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI - Performance Indicator)**

MODULE – 3

5.	**a.**	Explain the types of beam with sketches.	**08**	(2 :3 : 1.6.1)
	b.	Draw the shear force and bending moment diagrams for the beam shown in Fig. Q5 (b). Locate the point of contraflexure if any.	**12**	(3 :3 : 1.7.1)

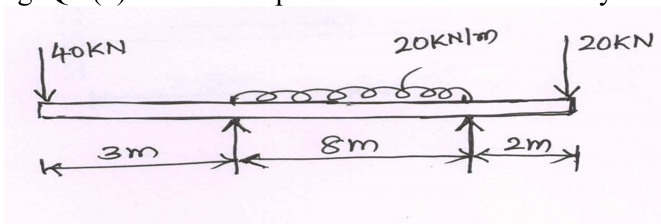

Fig. Q 5(b)

OR

6.	**a.**	List the assumptions and derive the bending equation $\frac{M}{I}=\frac{\sigma}{y}=\frac{E}{R}$.	**10**	(2 :3 : 1.6.1)
	b.	Two circular beams where one is solid of diameter ‘D’ and the other is a hollow of outer dia ‘D_0’ and inner dia ‘D_i’, are of same length, same material and of same weight. Find the ratio of section modulus of these circular beams.	**10**	(3 :3 : 1.7.1)

MODULE – 4

7.	**a.**	Derive an expression for deflection and slope of a beam subjected to uniform bending moment?	**10**	(2 :4 : 1.6.1)
	b.	A wooden beam 10 m long, 360 mm deep and 300 mm wide is simply supported and loaded with UDL for entire length. Maximum stress intensity of material is 60 MPa. Find the maximum stress if factor of safety is 6.	**10**	(3 :4 : 1.7.1)

OR

8.	**a.**	Derive the torsion equation for a circular shaft.	**10**	(2 :4 : 1.6.1)
	b.	A hollow shaft of external diameter 120 mm transmits 300 kW power at 200 rpm. Determine the maximum internal diameter if the maximum stress in the shaft is not to exceed 60 N/mm^2? Take outside diameter is equal to twice the inside diameter.	**10**	(3 :4 : 1.7.1)

MODULE – 5

9.	**a.**	Derive the Euler’s crippling load for a column when both ends are hinged or pinned.	**10**	(2 :5 : 1.6.1)
	b.	A hollow mild steel tube 6 m long 40 mm internal diameter 6 mm thick is used as a strut with both ends hinged. Find the crippling load and safe load taking factor of safety as 3. Take $E = 2 \times 10^5$ N/mm^2.	**10**	(3 :5 : 1.7.1)

OR

10.	**a.**	Define (i) strain energy (ii) Modulus of resilience (iii) Castigliano’s theorem-I (iv) Toughness (v) Castigliano’s theorem-II	**10**	(2 :5 : 1.6.1)
	b.	Derive an expression for strain energy due to shear stress.	**10**	(3 :5 : 1.7.1)

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Note: (**RBTL - Revised Bloom’s Taxonomy Level: CO - Course Outcome: PI - Performance Indicator)**