Basavarajeswari Group of Institutions

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

USN										Course Code	2	2	M	E	3	4

Third Semester B.E. Degree Examinations, September 2024

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.** Draw a stress-strain diagram with salient features for ductile materials **04** (2 :1: 1.4.1)

b. Define Stress. List and explain the types of stresses. **06** (1 :1: 1.4.1)

c. As shown in Fig. Q1 (c), a brass bar with a cross-sectional area of 1000 mm^2 is subjected to axial forces. Find the total elongation of the bar. Take E = 1.05 $\times 10^5$ N/mm^2 **10** (3 :1: 1.7.1)

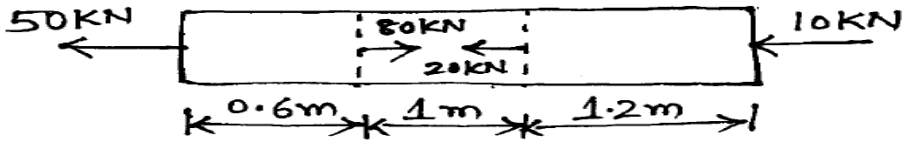

Fig. Q 1(c)

OR

2. **a.** Define (i) Modulus of Elasticity (ii) Modulus of rigidity and (iii) Bulk Modulus **06** (2 :1: 1.4.1)

b. Figure Q2 (b) shows A steel rod of 30 mm diameter enclosed centrally in a hollow copper tube with an external diameter of 50 mm and an internal diameter of 4 mm. The composite bar is then subjected to an axial pull of 45000 N. If the length of each bar is equal to 150 mm, determine.
(i) The stresses in the rod and tube, and
(ii) Load carried by each bar **14** (3 :1: 1.7.1)

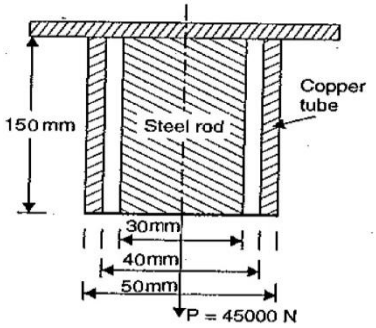

Fig. Q 2 (b)

Module-2

3. **a.** The direct stresses acting at a point in a strained material are shown in Fig. Q 3(a). Find the normal, tangential, and resultant stresses on plane 30° to the plane of major principal stress. Find the obliquity of the resultant. **10** (2 :2: 1.7.1)

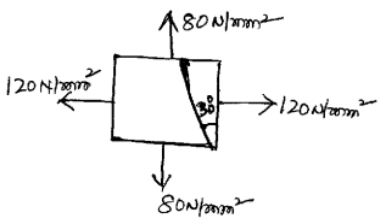

Fig. Q 3(a)

b. The direct stresses at a point in a strained material are 100 N/mm^2 compressive and 60 N/mm^2 tensile as shown in Fig. Q3(b). Find the stresses on the plane AC. **10** (2 :2: 1.7.1)

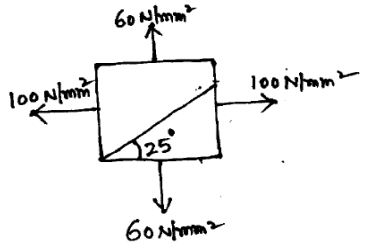

Fig. Q 3(b)

OR

4. **a.** Derive the expression for hoop stress in the case of the thin cylinder. **06** (2 :2: 1.4.1)

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 of 8 N/mm^2. Also, sketch the radial pressure distribution and hoop stress distribution across the section. **14** (2 :2: 1.7.1)

Module-3

5. **a.** What are the different types of beams? Explain briefly. **08** (2 :3: 1.4.1)

b. A cantilever beam of length 2 m carries point loads as shown in Fig. Q 5(b). Draw the shear force and bending moment diagrams for the beam. **12** (2 :3: 1.7.1)

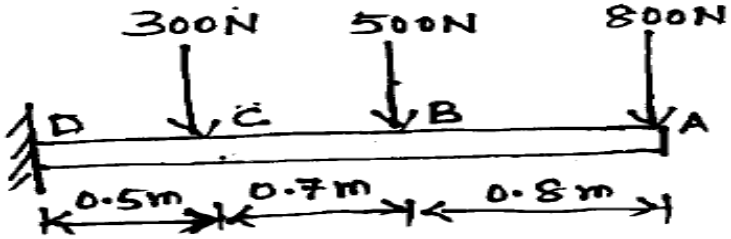

Fig. Q 5(b)

OR

6. **a.** Derive Equation of bending $\frac{M}{I}=\frac{\sigma}{y}=\frac{E}{R}$ **10** (2 :3: 1.4.1)

b. A rolled steel joist of I- section has the dimensions as shown in Figure Q 6(b). This beam of I section carries a UDL of 40 kN/m run on a span of 10 m, calculate the maximum stress produced due to bending. **10** (3 :3: 1.7.1)

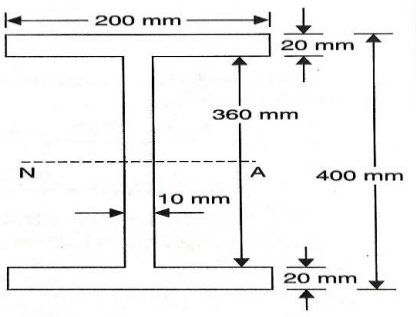

Fig. Q 6(b)

Module-4

7. **a.** Using the double integration method, determine the deflection of a cantilever beam with a point load at the free end. **10** (2 :4: 1.4.1)

b. Derive maximum deflection of a simply supported beam with uniformly distributed load (UDL) over the entire span. **10** (2 :4: 1.4.1)

OR

8. **a.** Derive the torsion equation with usual notations. **10** (2 :4: 1.4.1)

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

	b.	A hollow circular shaft has to transmit 60 kW at 210 rpm such that the maximum shear stress does not exceed 60 MN/m^2. If the ratio of the internal to the external diameter is equal to 3/4 and the value of rigidity modulus is 84 GPa, Find the dimension of the shaft and the angle of twist in a length of 3 m.	**10**	(2 :4: 1.7.1)

Module-5

9.	**a.**	Derive an expression for crippling load when both the ends of the column are hinged.	**10**	(2 :5: 1.4.1)
	b.	A solid round bar 3 m long and 50 mm in diameter is used as a strut with both ends hinged. Determine the crippling load. Take E = 2×10^5 MPa. Also, calculate the crippling load. (i) One end of the strut is fixed and the other end is free. (ii) Both ends are fixed (iii) One end is fixed and the other is hinged.	**10**	(2 :5: 1.7.1)

OR

10	**a.**	State Castigliono's theorem I and II.	**06**	(2 :5: 1.4.1)
	b.	Derive an expression for strain energy stored in a body when the load is applied with impact.	**14**	(2 :5: 1.4.1)

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