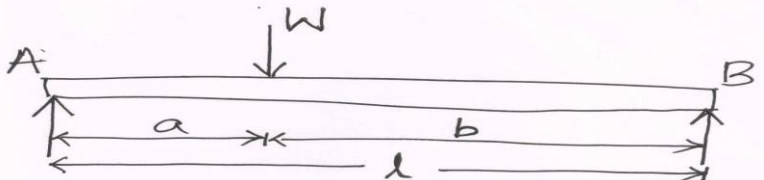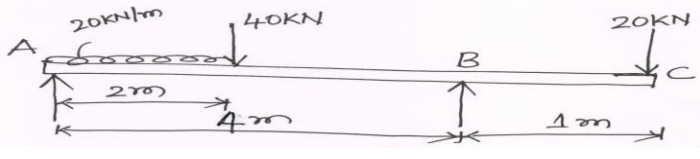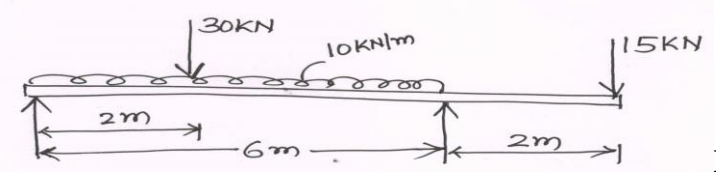| USN										Course Code		2	1	C	V	3	3

Third Semester B.E. Degree Examinations, September / October 2024
STRENGTH 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.**	Derive an expression for elongation of circular tapering bar subjected to an axial pull P.	**10**	(2 :1 : 1.3.1)
	b.	The following data refers to mild steel specimen tested in a laboratory. Diameter of specimen = 24 mm; Gauge length = 200 mm; Extension under load 100 kN = 0.04 mm; Yield point load = 150 kN; Maximum load = 225 kN; Neck diameter = 18.2 mm; Load at failure = 275 kN, length at failure =275 mm. Determine (i) Young's modulus; (ii) Yield stress (iii) Ultimate stress (iv) percentage elongation.	**10**	(3 :1 : 2.2.1)
		OR		
2.	**a.**	Derive the relation between modulus of rigidity (shear modulus) and modulus of elasticity.	**08**	(2 :1 : 1.3.1)
	b.	A steel rod of 18 m long at a temperature of 25^0c. Find the free expansion when the temperature is raised to 85^0c. Also find the temperature stress produced when: (i) The expansion is fully prevented (ii) The rod is permitted to expand by 4.5 mm E = 200 kN/mm^2 and $\alpha = 12 \times 10^{-6}/^0$C	**12**	(3 :1 : 2.2.1)
		MODULE – 2		
3.	**a.**	Draw SFD and BMD for the beam shown in Fig. Q 3(a).	**08**	(2 :2 : 1.3.1)

Fig. Q3 (a)

	b.	Draw SFD and BMD for the beam shown in Fig. Q 3(b). Also find maximum bending moment and locate point of contraflexure.	**12**	(3 :2 : 2.2.1)

Fig. Q3 (b)

OR

4.	**a.**	Define (i) Shear force (ii) Bending moment (iii) Point of contra flexure	**06**	(2 :2 : 1.3.1)
	b.	Draw the SFD and BMD for the beam shown in Fig. Q 4(b). Locate point of contraflexure.	**14**	(3 :2 : 2.2.1)

Fig. Q 4 (b)

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

MODULE – 3

5. **a.** Define (i) Neutral axis (ii) Section modulus (iii) Moment of resistance. **06** (2 :3 : 1.3.1)

b. A beam with T-section has a flange 100 mm wide and 20 mm thick, web 80 mm depth and thickness 15 mm is subjected to bending moment of 150 kN-m and shear force of 50 kN. Sketch the bending moment and shear stress distributing along the depth of the section. **14** (3 :3 : 2.2.1)

OR

6. **a.** Prove that for rectangular cross section maximum shear stress at the neutral surface is 1.5 times the average stress. **08** (2 :3 : 1.3.1)

b. A cantilever of length 2 m fails when the load of 2 kN is applied at the free end. If the section of the beam is 40 mm × 60 mm. Find the stress at the failure. **12** (3 :3 : 2.2.1)

MODULE – 4

7. **a.** State the assumption made in developing torsional equation. **08** (2 :4 : 1.3.1)

b. A solid shaft is to transit 340 kN-m at 120 rpm. If the shear stress of the material should not exceed 80 MPa, find the diameter required. What percentage saving in weight would be obtained if this shaft is replaced by a hollow one whose $d_i = 0.6d_o$, the length, material and shear stress remaining same. **12** (3 :4 : 2.2.1)

OR

8. **a.** For the element subjected to biaxial stress state, derive expressions for normal and tangential stresses acting on a plane inclined at an angle θ with the Y axis. **10** (2 :4 : 1.3.1)

b. Direct stresses of 120 MPa tension and 90 MPa compression are applied to an elastic Material at a centre point on the planes at right angles .The maximum principal stress is limited to 150 MPa. What is the corresponding shear stress on the given planes and what will be the maximum shearing stress at that point? **10** (3 :4 : 2.2.1)

MODULE – 5

9. **a.** Derive the relation between slope deflection and radius of curvature **08** (2 :5 : 1.3.1)

b. A simply supported steel beam having uniform cross section is 6 m long. It carries a concentrated load of 48 kN and 40 kN at two points 1m and 3 m from left end support. If the moment of inertia of the section is 85×10^6 mm^4 and E = 200 GPa, calculate (i) Deflection under loads (ii) Maximum deflection (iii) Slope at right hand support. **12** (3 :5 : 2.2.1)

OR

10. **a.** Derive the expression for Euler's buckling load for a column with both ends hinged. **08** (2 :5 : 1.3.1)

b. A solid round bar 4 m long and 50 mm in diameter is used as a strut with both ends fixed. Compare Euler's crippling load and Rankine's crippling load for the bar and also find the length of bar for which both formulas give same load. Take E= 80 GPa. **12** (3 :5 : 2.2.1)

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