

Third Semester B.E./B.Tech. Degree Examination, June / July 2026
Mechanics of Materials

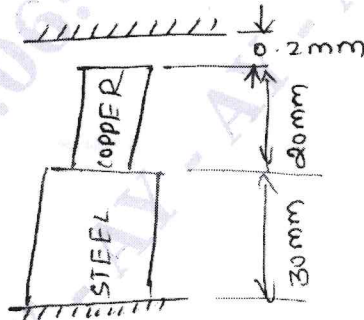
Time: 3 hrs

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

Module – 1			M	L	C
Q.1	a.	Explain state of stress at a point.	06	L2	CO1
	b.	State and explain Hooke's Law.	04	L2	CO1
	c.	Define the following terms: i) Factor of safety ii) Bearing stress iii) Modulus of Rigidity iv) Poisson's Ratio v) Volumetric Strain	10	L1	CO1

OR

Q.2	a.	Derive an expression for total elongation in an uniformly Tapering Circular Bar.	10	L3	CO1
	b.	The composite bar shown in figure Q. 2 (b) is 0.2 mm short of distance between the rigid supports at room temperature. What is the maximum temperature rise which will not produce stresses in the bar? Find stresses induced when temperature rise is 40°C. Given : $\alpha_s = 12 \times 10^{-6} \text{ per } ^\circ\text{C}$ $\alpha_c = 17.5 \times 10^{-6} \text{ per } ^\circ\text{C}$ $E_s = 2 \times 10^5 \text{ N/mm}^2$ $E_c = 1.2 \times 10^5 \text{ N/mm}^2$ $A_s : A_c = 4 : 3$ 	10	L3	CO1

Module – 2

Q.3	a. Derive the relation between shear force, load and bending moments.	06	L3	CO2
	b. Draw shear force and bending moment diagrams for the beam shown in figure Q. 3 (b) locate point of inflexion if any.	14	L3	CO2

The diagram shows a horizontal beam with five supports labeled A, B, C, D, and E. The beam is divided into four segments by these supports. The first segment (A to B) has a length of 5m and is subjected to a uniformly distributed load of 10 kN/m acting downwards. The second segment (B to C) has a length of 2.5m and has a point load of 80 kN acting downwards at support B. The third segment (C to D) has a length of 5m and has a point load of 80 kN acting downwards at support C. The fourth segment (D to E) has a length of 2.5m and has a point load of 16 kN/m acting downwards at support D. The beam is supported by vertical reaction forces at each of the five points A, B, C, D, and E.

Fig. Q.3 (b)

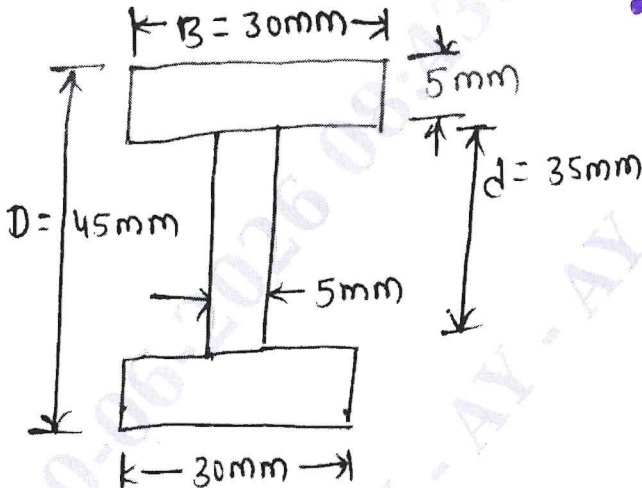
Q.4	a.	Derive the relation between bending moment and radius of curvature.	08	L3	CO2
	b.	A I section as shown in figure Q. 4 (b) spans two supports 5 m apart. A 10 kN load is distributed uniformly on the entire span of beam. Calculate maximum shear stress and draw the shear distribution diagram. 	12	L3	CO2
		Fig. Q. 4 (b)			

Fig. Q. 4 (b)

Module – 3

Q.5	a.	Derive the differential equation deflected beam (OR) Relation between slope, deflection and radius of curvature.	10	L3	CO2
	b.	A steel cantilever 6 m long carries two point loads, 15 kN at the free end and 25 kN at a distance of 2.5 m from the free end. Find : i) Slope at the free end ii) Deflection at the free end	10	L3	CO2

OR

Q.6	a.	A hollow circular steel 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 internal to external diameter is equal to 3/4 and the value of rigidity modulus is 84 GPa find the dimensions of the shaft and angle of twist in a length of 3 m.	10	L3	CO2
	b.	Compare the weight, strength and stiffness of hollow shaft of same external diameter as that of solid shaft. The inner diameter of hollow shaft is half the external diameter. Both the shafts have the same material and length.	10	L3	CO2

Module – 4

Q.7	a.	Explain principle of virtual work applied to mechanical system.	10	L2	CO1
	b.	What is “Principle of Minimum Potential Energy”?	10	L1	CO1

OR

Q.8	a.	State and explain Castigliano's first and second theorem.	10	L2	CO2
	b.	Derive an expression for internal strain energy stored within an elastic bar subjected to torque 'T'.	10	L3	CO2

Module – 5

Q.9	a.	Explain Type I and Type II fracture.	10	L2	CO3
	b.	Define Creep and explain three stages of creep.	10	L1	CO3

OR

Q.10	a.	Define 'Fatigue'. List and explain the factors that affect the fatigue life.	10	L2	CO3
	b.	Draw S - sN diagram and explain in detail.	10	L2	CO3