U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: IV**

Branch: Aerospace Engineering **Duration: 3 hrs.**

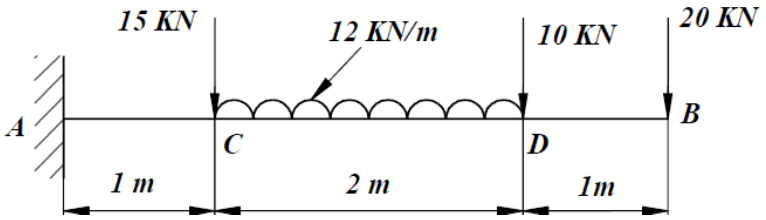
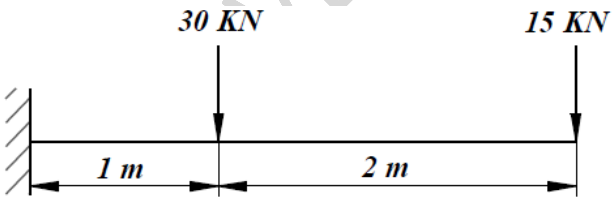
Course Code: 23AS4PCSDM / 22AS4PCSDM / 19AE4DCASM **Max Marks: 100**

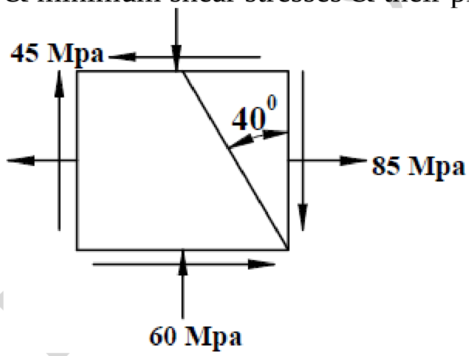
Course: Solid Mechanics

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	Explain the following Elastic Constants with suitable equations (a)Young's modulus of elasticity (E) (b)Rigidity or shear modulus of elasticity (C or G) (c)Bulk modulus of elasticity (K) (d)Poisson's ratio (μ)	CO1	PO1	**10**
	b)	The diameter of a specimen is found to reduce by 0.004 mm when it is subjected to a tensile force of 19 KN. Initial diameter of the specimen is 20 mm. Taking the modulus of rigidity for the material of specimen as 40 GPa, determine the values of young's modulus and Poisson's ratio.	CO1	PO2	**10**
		OR			
2	a)	Derive the relationship between modulus of elasticity, modulus of rigidity and bulk modulus. State the assumptions made.	CO1	PO1	**10**
	b)	A steel tube of 50 mm external diameter and 5 mm thickness encloses centrally a copper bar of 30 mm diameter and a length of 1m. The bar and tube are rigidly connected together at the end at a temperature of 30°C. The composite bar is subjected to one axial compressive load of 60 kN and the temperature is raised to 150°C. Determine the stresses in the steel tube. Take the thermal expansion coefficients for steel as $12 \times 10^{-6}/°C$ and copper as $18 \times 10^{-6}/°C$, Elasticity as E_{steel} = 200 GPa and E_{copper} = 100 GPa.	CO1	PO2	**10**
		UNIT - II			
3	a)	Explain the following beams with sketches with showing known slope and deflection at various points on the beam. i. Cantilever Beam ii. Simply Supported Beam iii. Fixed Beam iv. Overhanging Beam v. Continuous Beam	CO2	PO1	**10**

	b)	A cantilever beam carries UDL & Point loads as shown in Fig.3b Draw the shear force diagram (SFD) & the Bending Moment diagram (BMD)  Fig. 3b	*CO2*	*PO2*	**10**
		OR			
4	a)	Discuss the relationship between Bending Moment & Shear Force with sketches if any	*CO2*	*PO1*	**10**
	b)	A rectangular section beam (300mm×400mm) is simply supported over a span of 6m. The beam carries UDL of intensity 'w' over the entire span. If the intensity of stress is limited to 10 MPa. Determine the maximum value of w.	*CO2*	*PO2*	**10**
		UNIT - III			
5	a)	Derive Deflection Equation with respect to deflection of beams	*CO3*	*PO1*	**10**
	b)	A cantilever beam is subjected to forces as shown in Fig.5b Determine the slope and deflection at points B & C.  Fig. 5b	*CO3*	*PO2*	**10**
		OR			
6	a)	Discuss the Macaulay's and Castigliano method w.r.t deflection of beams	*CO3*	*PO1*	**10**
	b)	A beam of length 6m is supported at its ends and carries two point loads of 48 KN and 40 KN at a distance of 1m and 3m respectively from the left support. Take E=200 GPa & I=85x10^{-6} m^4. Find; (i)Deflection under each load (ii)Maximum deflection & its location **Note**: E=200 GPa= 200x109 pa= 200x106 kPa. Substitute E in kN/m^2 & I in m^4 as the loads are taken in kN & distances in meters.	*CO3*	*PO2*	**10**
		UNIT - IV			
7	a)	Derive the torsional formula $\frac{T}{J}=\frac{\tau}{r}=\frac{G\theta}{L}$ with usual notation for the circular shaft. State the assumptions made.	*CO4*	*PO1*	**10**

		b)	A shaft is required to transmit 1 MW at 240 rpm. The shaft must not twist more than 10 over a length of 15 diameters. If the modulus of rigidity of shaft material is 80 KN/mm2, find the diameter of the shaft and shear stress induced.	*CO4*	*PO2*	**10**
			OR			
	8	a)	Derive Euler's equation for both ends fixed condition.	*CO4*	*PO1*	**10**
		b)	A column has a square section of side 40 mm. Taking the factor of safety as 4, determine the safe load for the end conditions, (i) Both ends hinged (ii) One end is fixed and the other end free (iii) Both ends fixed (iv) One end fixed & the other hinged. Take E=210 Gpa.	*CO4*	*PO2*	**10**
			UNIT - V			
	9	a)	Define Principal stresses & Principal planes. Starting with the equations of stresses on an oblique plane, obtain the expressions for principal stresses & their orientations.	*CO4*	*PO1*	**10**
		b)	A point in a strained material is subjected to loads as shown in Fig.9b Determine; (i)Normal & tangential stresses on the oblique plane (ii)Major & minor principal stresses & their planes. (iii)Maximum & minimum shear stresses & their planes.  Fig. 9b	*CO4*	*PO2*	**10**
			OR			
	10	a)	Explain the following theories of failure with the equations i. Shear Stress ii. Strain Energy iii. Distortion Energy	*CO5*	*PO1*	**10**
		b)	A mild steel shaft of 60 mm dia. is subjected to a bending moment of 2.5 kNm & a twisting moment 'T'. If The yield strength of shaft material in tension is 200 MPa, find the maximum value of torque at which the shaft just begins to yield, according to; 1. Maximum Principal Stress theory 2. Maximum shear Stress theory 3. Distortion energy theory	*CO5*	*PO2*	**10**

******