Ref. No. :- Ex/CON/PC/B/T/212/2024

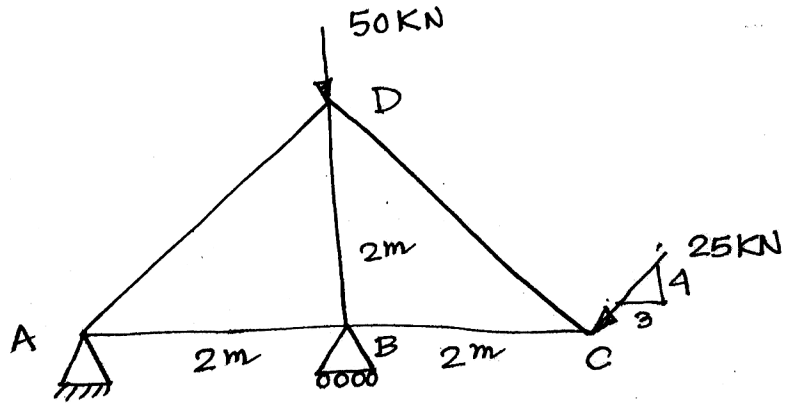
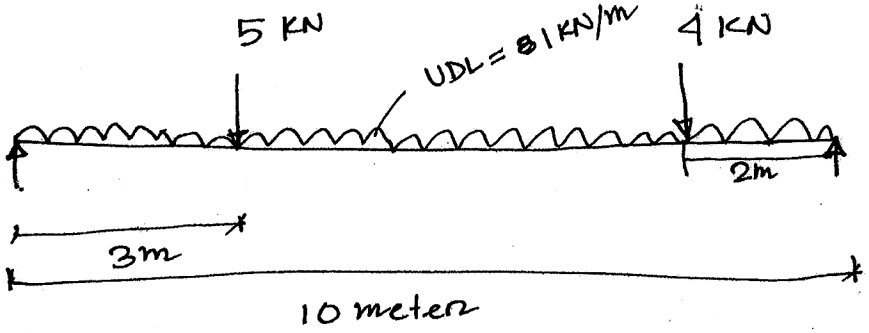
B. CONS. ENGG. 2ND YR 1ST SEMESTER EXAM-2024

STRENGTH OF MATERIALS

Time : Three Hours **Full Marks : 50**

Group / Part : Part I

Instructions: Use Separate Answer Scripts for Each Group/Part Etc.
Answer All Questions

No. of Questions	Part I	Marks
Q1.	 Solve the above-mentioned truss structure and find forces of all members (compression & tension) by method of joint.	25
Q2.	 Find Shear force diagram of above-mentioned beam.	15
Q3.	Derive the relation between Bending Moment (M) and Shear force (F) of a beam member.	10

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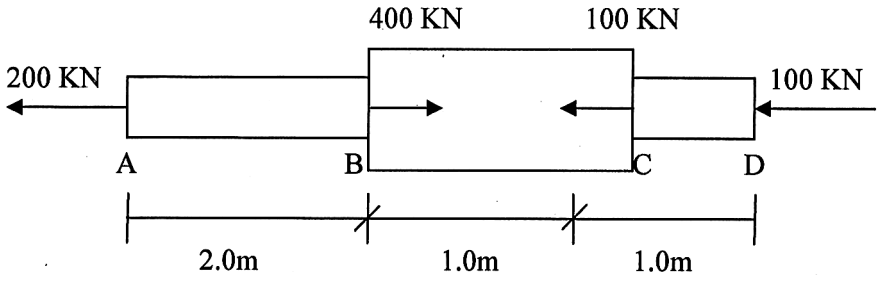
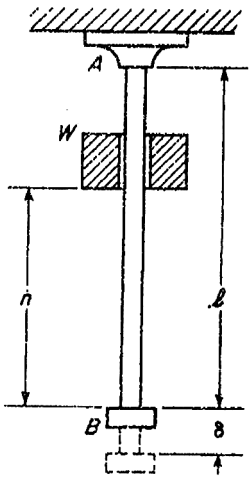
SUBJECT Strength of Material

Time : 3 hours. **Full Marks : 50**

Use Separate Answer scripts for each Part

	No of Questions	Part II	Marks
CO1		**Answer any three from Q1, Q2, Q3 and Q4.**	
	Q1.	An elastic steel bar of variable cross section is subjected to axial loads as shown in the Fig.- A. The cross sectional areas of segments AB, BC and CD are 1000 mm², 2000 mm² and 1000mm² respectively. Evaluate the elongation of the bar. E = 20 x 105 MPa.  **Fig. A**	07
	Q2.	Derive the relation between Young's modulus E, Poisson's ratio μ and shear modulus G.	07
	Q3.	A steel rod 50mm in diameter and 3.0m long is suspended from one end and has a weight 5 kN threaded on to it (Fig. B). The weight is allowed to fall freely from a height of 3 cm on to the head formed on the lower end of the rod. Find the maximum stress produced in the rod. Assume E = 2.1 x 10^5 N/mm².  **Fig. B**	07

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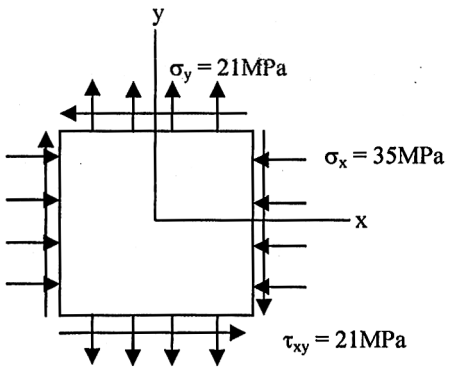
Time : 3 hours. **Full Marks : 50**

	No of Questions	Part II	Marks
	Q4.	A circular bar of 50mm dia and 250mm length is subjected to a pull of 50kN. The elongation in length of the bar is recorded as 0.0318mm and the reduction in diameter is 0.0019mm. Calculate Modulus of Elasticity, Poisson's ratio, Bulk modulus and Shear modulus.	07
CO2		**Answer Q5 and any two from Q6, Q7 and Q8.**	
	Q5.	Find out the correct answer a) If an element of a stressed body is in a state of pure shear with a magnitude of 80 Nmm^2, the magnitude of maximum principal stress at that location is i) $80N/mm^2$ ii) $113.14N/mm^2$ iii) $120N/mm^2$ iv) $56.57N/mm^2$ b) If principal stresses in a two dimensional case are (-)10MPa and 20MPa respectively, then maximum shear stress at the point is i) 10MPa ii) 15MPa iii) 20MPa iv) 30MPa	02
	Q6.	A plane element is subjected to stresses as shown in Fig. C. Draw Mohr's Circle and determine a) The principal stress and their directions. b) The maximum shear stress and the direction of the planes on which they occur.  **Fig. C**	08

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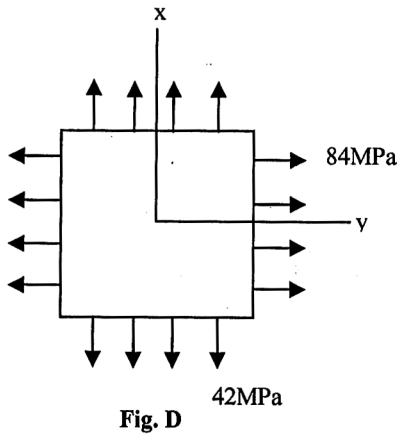
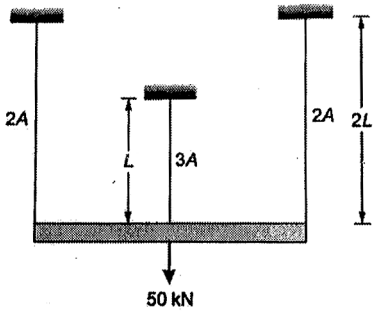
Time : 3 hours. **Full Marks : 50**

	No of Questions	Part II	Marks
	Q7.	For the particular case of biaxial tension shown in Fig. D, construct Mohr's circle and find the angle ϕ defining the plane on which the ratio of normal stress to shear stress is a minimum.  **Fig. D**	08
	Q8.	A rigid bar is suspended by three rods made of same material (Fig E). The area and length of the central rod are 3A and L respectively while that of the two outer rods are 2A and 2L respectively. If a downward force of 50kN is applied to the rigid bar, find out the forces in the central and each of the outer rods.  **Fig. E**	08
CO4		**Answer Q11 and any one from Q12a and Q12b.**	
	Q9.	The maximum and minimum shear stresses in a hollow circular shaft of outer diameter 20mm and thickness 2mm, subjected to a torque of 92.7 N-m will be i) 59 MPa and 47.2 MPa ii) 100 MPa and 80MPa iii) 118MPa and 160MPa iv) 200 MPa and 160MPa	02

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	No of Questions	Part II	Marks
	Q10.	A hollow aluminum tube used in a roof structure has an outside diameter of 100 mm and an inside diameter of 80 mm. The tube is 250cm long. Assume $G = 0.28 \times 10^5$ MPa a) If the tube is twisted in pure torsion by torques acting at the ends, what is the angle of twist when the maximum shear stress is 50 MPa? b) What diameter is required for a solid shaft to resist the same torque with the same maximum stress? c) What is the ratio of the weight of the hollow tube to the weight of the solid tube?	09
	Q11.	A solid shaft is to transmit 400 hp at 100 rpm. If the shear stress is not to exceed 80 MPa, find the diameter of the shaft. What percentage saving in weight would be obtained if this shaft is replaced by a hollow one whose internal diameter equals to 0.6 times its external diameter? The length, material and maximum shear stress is the same for both the solid and hollow cylinder.	09