Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–III EXAMINATION – WINTER 2025

Subject Code:3130608 Date:19-12-2025

Subject Name: Mechanics of Solids

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

Q.1 **(a)** State and explain The Lami's theorem. **03**

(b) State and explain **04**

(i) Principle of transmissibility of force,

(ii) Principle of superposition.

(c) Fill in the blanks : **07**

(i) At neutral axis , bending stress in the beam is _____

(ii) The shear taken by the web of an I section is _____ flange.

(iii) _____ Beams have one end fixed and the other free.

(iv) The value of bending moment at the point of contra flexure will always be ___

(v) A _____has the same effect as the combined effect of forces that it replaces.

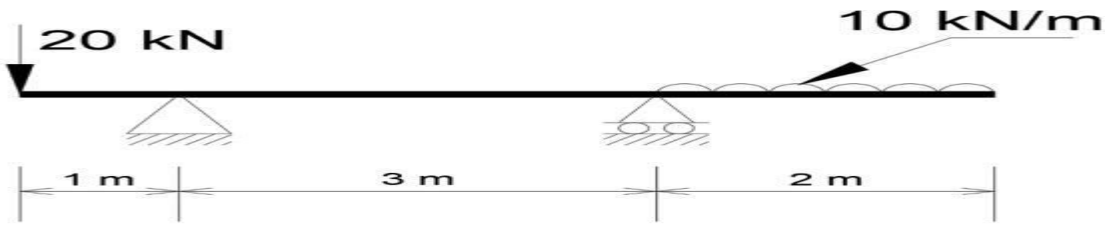
(vi) Mathematical equation of perpendicular axis theorem is _____

(vii) Frictional force will always be in a direction ___ to that in which the body tends to move.

Q.2 **(a)** Define: (1) Shear Force (2) Bending Moment (3) Points of contra flexure. **03**

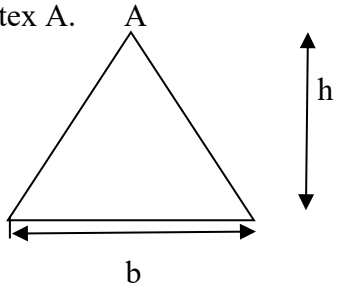
(b) Derive the relationship between rate of loading, shear force and bending moment. **04**

(c) Draw shear force diagram and bending moment diagram for a beam shown in fig.1 **07**



OR

(c) Find the moment of inertia of a triangular area about its centroidal axes and about the vertex A. **07**



Q.3 **(a)** State and explain with an example the Pappus-Guldinus theorems. **03**

(b) A steel bar of 1 meter length is subjected to 120 kN axial tensile force. The C/S of bar is 20 mm x 20 mm. The increase in length is found to be 0.5 mm and decrease in thickness is 0.003 mm. Find the value of Young's modulus and poisson's ratio. Thi **04**

(c) Define following : **07**

i. Moment of inertia of a section,
ii. Polar moment of inertia,
iii. Radius of gyration
iv. Section Modulus

OR

Q.3 **(a)** Using first principle, obtain the distance of centroid of a right-angled triangular lamina from the base. **03**

(b) Find the support reaction for beam which is loaded as shown in **Fig.** **04**

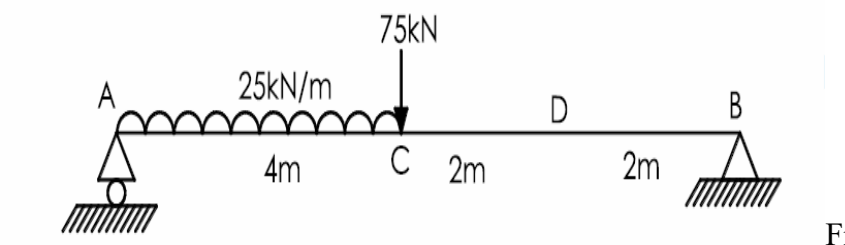


Fig. 2

(c) Calculate the maximum bending stress and maximum shear stress at a section for the beam shown in Figure-2. Beam cross section is 300mm wide × 500mm deep. **07**

Q.4 **(a)** Write down assumptions made in analysis of plane trusses. Enlist methods of analysis of plane trusses. **03**

(b) Define and explain significance of following terms/quantities. **04**

i Volumetric strain,
ii Poisson's ratio,
iii Lateral strain,
iv Modulus of elasticity,

(c) A simply supported beam of span 4.0 m having uniform section of size 200 mm width and 400 mm depth is loaded with uniformly distributed load of 40 kN/m over entire span. Determine the maximum bending moment along the span and draw the bending stress distribution across the section. **07**

OR.

Q.4 **(a)** Derive the formula for shear stress distribution in a rectangular beam section. **03**

(b) Derive theory of pure bending with usual notations. **04**

(c) A "T" section has a flange 160 mm X 12.5 mm and web 188 mm X 8 mm. It is used as a beam over span of 4.0 m to carry uniform load of 16 kN/m. Sketch the shear stress distribution at the section of maximum shear force. **07**

Q.5 **(a)** Describe the Mohr's circle method to calculate principal stresses. **03**

(b) An elastic material is subjected to two direct stresses of 200 N/ mm^2 and 80 N/ mm^2 tensile at right angles to each other. If major principal stress is limited to 210 N/ mm^2 compressive, find the value of shear stress that can be applied to the material. Also find minor principal stress. **04**

(c) Derive the torsion formula for cylindrical shaft. State the assumptions taken in derivation of torsion formula. Define the torsional rigidity. **07**

OR.

Q.5 **(a)** State and explain Varignon's principal of moments. **03**

(b) Derive the equation for deformation and stresses in composite structures. **04**

(c) A solid circular shaft has to transmit 300 kW power at 210 r.p.m. The limiting shear stress is 50 N/mm^2 and the permissible angle of twist is 1° in 3.0 m length of the shaft. Determine the minimum diameter of shaft required to transmit the power. Take G = 0.8 X 10^5 N/mm^2. **07**

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–III (NEW) EXAMINATION – WINTER 2024

Subject Code: 3130608 Date: 06-12-2024

Subject Name: Mechanics of Solids

Time: 10:30 AM TO 01:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Define following terms; i) Rigid body ii) Mass iii) Equilibrant	**03**
	(b)	State any two assumptions made in analysis of plane trusses. Plot neat sketch of perfect truss, deficient truss and redundant truss.	**04**
	(c)	Obtain the magnitude and direction of equilibrant force for the force system shown in Figure-1.	**07**

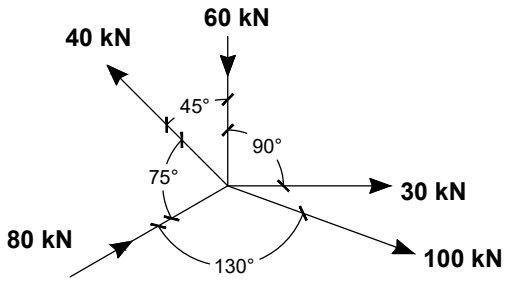


Figure-1

Q.2	**(a)**	State and explain the Law of polygon of forces.	**03**
	(b)	Derive the relation, with usual notations, among loading, shear force and bending moment at a section for a determinate beam.	**04**
	(c)	Calculate support reactions for the beam shown in Figure-2. Also plot Bending Moment and Shear Force diagrams showing values at important locations.	**07**
		OR	
	(c)	Calculate support reactions for the beam shown in Figure-2. Also obtain the location of maximum Bending Moment, Maximum Bending Moment and Maximum Shear Force in the beam.	**07**

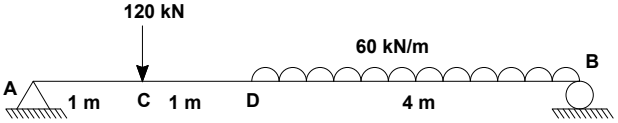


Figure-2

Q.3	**(a)**	State Pappus-Guldinus Theorems.	**03**
	(b)	From first principle obtain the location of center of gravity of semi-circular lamina.	**04**
	(c)	Calculate the bending stress at point ‘C’ for the beam shown in Figure-2. Given that the beam cross section 300mm wide × 600mm deep and modulus of elasticity as 25000MPa.	**07**

OR

Q.3 **(a)** State parallel axes theorem and perpendicular axes theorem. **03**

(b) Using first principle obtain the equation to obtain moment of inertia of a circular section about centroidal x-axis. **04**

(c) Calculate the shear stress at point 'D' for the beam shown in Figure-2. Given that the beam cross section 300mm wide × 600mm deep and modulus of elasticity as 25000MPa. **07**

Q.4 **(a)** Define the following terms; **03**

i) Modulus of elasticity
ii) Poisson's ratio
iii) Modulus of rigidity

(b) With usual notations, derive the relationship among Modulus of elasticity, Poisson's ratio and Bulk modulus. **04**

(c) A solid shaft of 250 mm diameter has the same cross-sectional area as that of hollow shaft of the same material of inside diameter 200 mm. Find the ratio of power transmitted by the two shafts at same angular velocity. Also, compare angle of twist in equal lengths of these shafts when stressed to the same intensity. **07**

OR

Q.4 **(a)** Give assumptions made in the theory of torsion. **03**

(b) For the shaft subjected to pure torsion, derive the torsion equation with usual notations. **04**

(c) Calculate the stress and elongation of each part of the bar shown in Figure-3. Also, calculate total change in length of the bar. Take E = 200000MPa. **07**

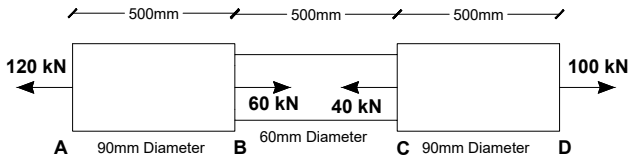


Figure-3

Q.5 **(a)** State and explain Hook's law. **03**

(b) Explain Mohr's circle method with neat sketch for a section subjected to direct stresses along two perpendicular directions. **04**

(c) A bar held straight between two rigid supports 5 m apart has initial tensile stress 5 MPa at 30° Celsius. Calculate the stress in wire if temperature reduces to minus 5° C. Take E= 2×10^5 MPa and coefficient of thermal expansion as 2×10^{-6} per °C. **07**

OR

Q.5 **(a)** Define Stress, Strain and Bulk modulus. **03**

(b) Explain Mohr's circle method with neat sketch for a section subjected to direct stresses along two perpendicular directions and accompanying shear stresses. **04**

(c) Determine the compressive stress developed in a punch of 10 mm diameter, used to make a hole of 10mm diameter in 6mm thick mild steel plate. The shear strength of mild steel is 200MPa. **07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III (NEW) EXAMINATION – WINTER 2023

Subject Code:3130608 Date:23-01-2024

Subject Name:Mechanics of Solids

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	State following laws: 1) Principle of Superposition 2) Principle of Transmissibility of Forces	**03**
	(b)	State and explain parallelogram law of forces.	**04**
	(c)	For the concurrent force system shown in **Figure-1**, calculate the magnitude and direction of Resultant force **using Graphical method**.	**07**

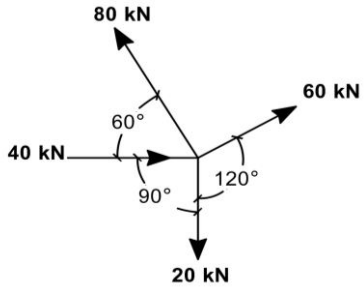


Figure-1

Q.2	**(a)**	Write down assumptions made in analysis of plane trusses. Also, enlist methods of analysis of plane trusses.	**03**
	(b)	Calculate support reactions for the beam shown in **Figure-2**.	**04**

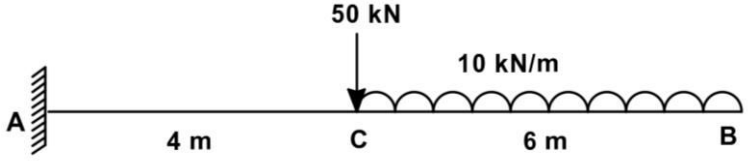


Figure-2

	(c)	For the beam shown in **Figure-3**, calculate support reactions and plot shear force diagram. Also, obtain value of maximum positive shear force.	**07**

OR

(c) For the beam shown in **Figure-3**, calculate support reactions and plot Bending Moment Diagram. Also, obtain value of maximum bending moment in the beam. **07**

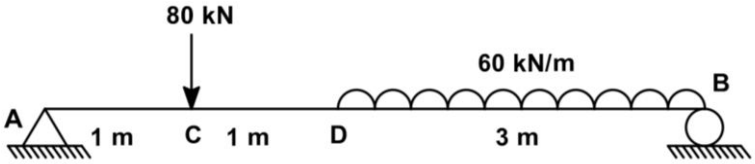


Figure-3

Q.3 **(a)** Plot shear stress distribution across the section for **03**
(1) Circular cross section (2) Symmetric 'I'-Section

(b) Obtain value of maximum shear stress at a section for rectangular cross section using first principle. **04**

(c) For the beam shown in **Figure-2**, calculate the maximum Bending stress induced at a section. Take beam cross section 300mm (width) x 600mm (depth). Also, plot bending stress variation across the section. **07**

OR

Q.3 **(a)** Write assumptions made in derivation of equation of bending. **03**

(b) Derive theory of pure bending with usual notations. **04**

(c) For the beam shown in **Figure-2**, calculate the maximum shear stress induced at a section. Take beam cross section 300mm (width) x 600mm (depth). Also, plot shear stress variation across the section. **07**

Q.4 **(a)** Give statement of Pappus-Guldinus **First theorem** and state its application. **03**

(b) Using first principle, obtain the location of centroid of semi-circular plate from the straight face of the section. **04**

(c) For the beam section shown in **Figure-4**, obtain the moment of inertia about x-x axis passing through the base of the section. **07**

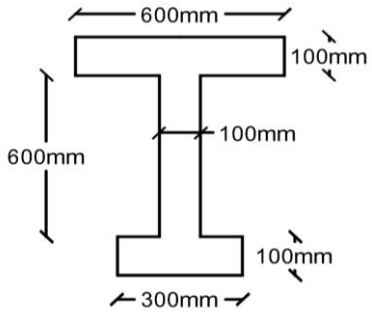


Figure-4

OR

Q.4 **(a)** State assumptions made in derivation of Torsion formula. **03**

(b) State and explain Parallel axes theorem. **04**

(c) For the beam section shown in **Figure-4**, obtain the location of centroid. **07**

Q.5 **(a)** Define Elasticity and State Hook's law. **03**

(b) For a two dimensional system subjected to tensile stresses along on both perpendicular directions, derive an equation to obtain principal stress on any one principal plane. **04**

(c) A steel rod having 30 mm diameter and 500 mm length is subjected to rise in temperature through 80˚C. Calculate the extension of the rod due to rise in temperature. Also, calculate the value of 'P', if the rod is held in position by axial force 'P' to prevent the expansion. Take $E_s = 200GN/m^2$ and $\alpha_s = 12 \times 10^{-6}$ per °C. **07**

OR

Q.5 **(a)** Describe the Mohr's circle method to obtain stress at a point on an incline plane for the two dimensional system subjected to tensile stresses on both perpendicular directions. **03**

(b) For a two dimensional system subjected to tensile stresses along on both perpendicular sides, derive an equation to obtain inclination of principal plane. **04**

(c) A bar ABCD of circular section is rigidly fixed at ends A and D. The bar is subjected to axial loads as shown in **Figure-5**. Length AB = BC = CD = 400 mm. The diameter of portions AB, BC and CD are 25mm, 50mm and 75mm, respectively. Find the loads shared by each portion of the bar and change in length of each portion of the bar, neglecting any bending effects. Take $E=200kN/mm^2$. **07**

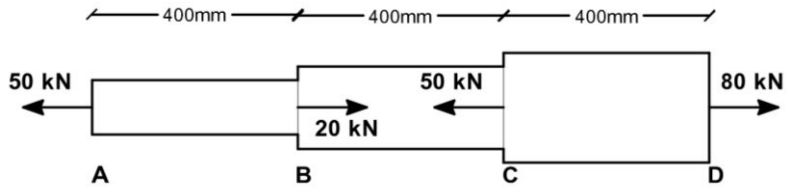


Figure-5

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– III(NEW) EXAMINATION – WINTER 2022

Subject Code:3130608 Date:01-03-2023

Subject Name:Mechanics of Solids

Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

Q.1	**(a)**	Explain following terms (i) Rigid body (ii) Deformable body (iii) Elastic body.	**03**
	(b)	State and explain parallelogram law of forces.	**04**
	(c)	Determine the location of centroid of plane lamina shown in **Figure 1** with respect to point A.	**07**
Q.2	**(a)**	Write the assumptions made in the analysis of perfect truss.	**03**
	(b)	Find magnitude and direction of resultant for forces system as shown in **Figure 2.**	**04**
	(c)	Replace the forces acting on the road by an equivalent single resultant force and couple system acting at point A for **Figure 3.**	**07**
		OR	
	(c)	Find the I_{xx} and I_{yy} for section shown in **Figure 4**.	**07**
Q.3	**(a)**	Explain: (i) Type of beams (ii) Type of loading on the beams.	**03**
	(b)	Derive using first principle the equation for calculation of maximum shear stress at a section for a beam with rectangular cross section.	**04**
	(c)	Find support reaction and draw **S.F.D** and **B.M.D** for beam which is shown in **Figure 5.**	**07**
		OR	
Q.3	**(a)**	Explain following terms: (i) Shear force (ii) Bending moment (iii) Point of contra flexure.	**03**
	(b)	Find support reaction for beam which is shown in **Figure 5.**	**04**
	(c)	Find support reaction and draw **S.F.D** and **B.M.D** for beam which is shown in **Figure 6.**	**07**
Q.4	**(a)**	Explain assumptions made in theory of pure bending.	**03**
	(b)	Draw shear stress distribution diagram for Rectangular, Circular T section and I section.	**04**
	(c)	Determine deformation in each part of the bar ABCD shown in **Figure 7.**	**07**
		OR	
Q.4	**(a)**	Define stress, strain and poisson ratio.	**03**
	(b)	A solid circular shaft of 300 mm diameter has transmit 600 kW power at 200 R.P.M. Calculate maximum shear stress in shaft material.	**04**

(c) A beam of T shaped cross section is shown in **Figure 8.** is subjected to bending moment of 20 kN.m. Find the bending stress at the top and bottom of beam. **07**

Q.5 **(a)** Derive with usual notations the theorem of perpendicular axis. **03**

(b) Determine torque transmitted by hollow circular shaft of 100 mm external diameter and 70 mm internal diameter if maximum shear stress is not exceed 80 N/mm^2. **04**

(c) A beam of T shaped cross section is shown in **Figure 8.** is subjected to shear force of 50 kN. Find the maximum shear stress in section. **07**

OR

Q.5 **(a)** Define principal planes and principal stresses. **03**

(b) A steel bar of rectangular cross-section 25 mm x 40 mm carries an axial tension of 40 kN. Determine the average tensile stress in bar. **04**

(c) Determine normal and tangential stress on plane AB, in a strained material shown in **Figure 9.** **07**

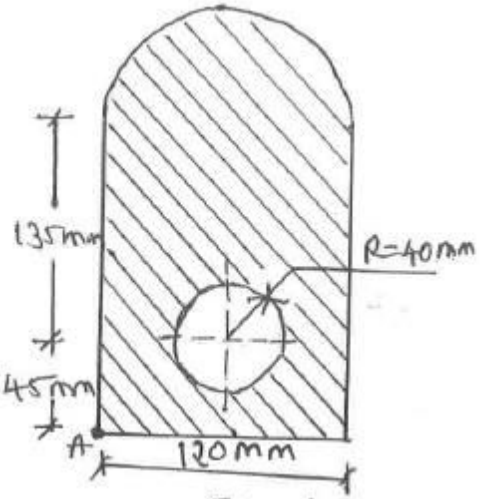


Fig-1

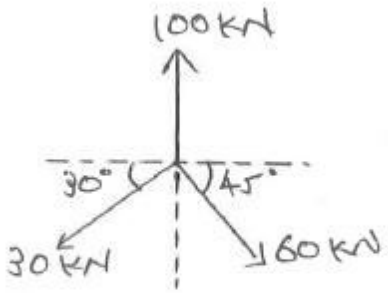


Fig-2

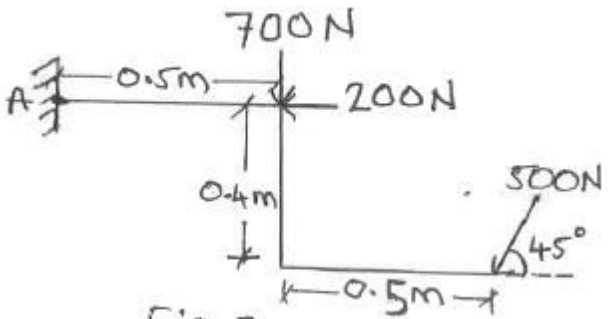


Fig-3

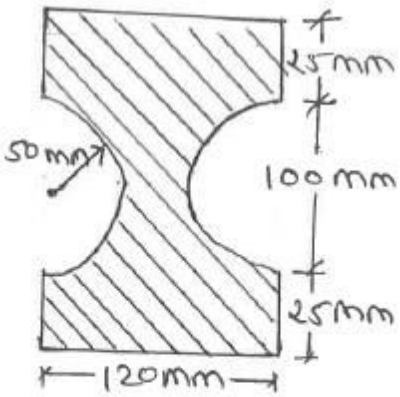


Fig-4

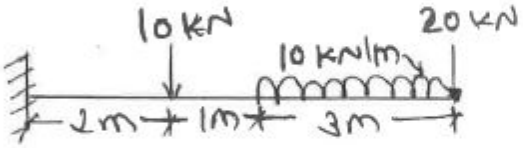


Fig-5



Fig-6

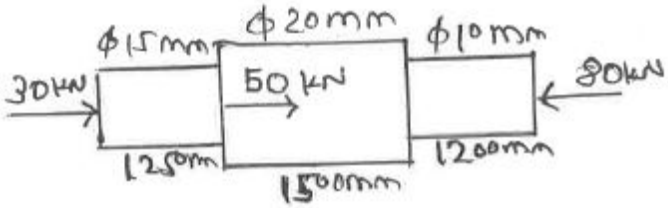


Fig-7

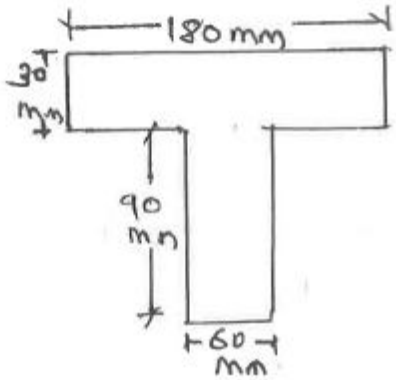


Fig-8

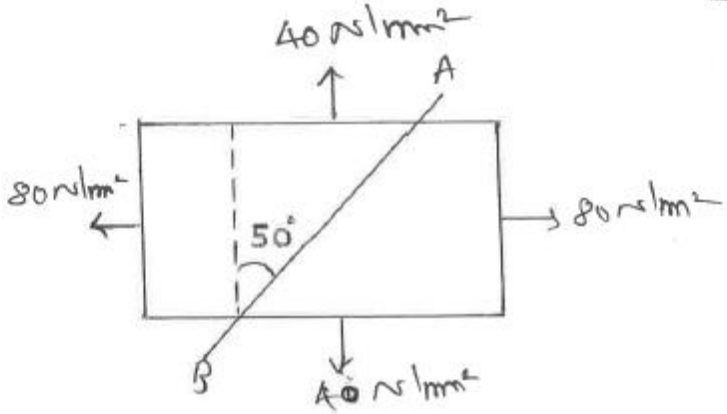


Fig-9

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