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GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VI (NEW) EXAMINATION – WINTER 2020

Subject Code:2160609 **Date:03/02/2021**

Subject Name:Computational Mechanics

Time:02:00 PM TO 04:00 PM **Total Marks: 47**

Instructions:

1. **Attempt any THREE questions from Q.1 to Q.6 .**
2. **Q.7 is compulsory.**
3. **Make suitable assumptions wherever necessary.**
4. **Figures to the right indicate full marks.**

Q.1	**(a)**	Derive member stiffness matrix of beam member.	**03**
	(b)	Derive the relationship $A_S = R^T A_M$ for rotation of axis in 2D.	**04**
	(c)	Using member stiffness approach, determine joint displacement for the beam loaded as shown in fig.1. Take EI = 60 kNm^2.	**07**
Q.2	**(a)**	Explain symmetry and anti-symmetry with neat sketches.	**03**
	(b)	Write rotation matrices of plane truss member and plane frame member.	**04**
	(c)	Using member stiffness approach, determine joint displacements for the beam loaded as shown in fig.1, if the support 'A' rotates by 10^o counter-clockwise. Take EI = 60 kNm^2.	**07**
Q.3	**(a)**	Evaluate member stiffness matrices of the truss shown in fig.3.	**03**
	(b)	Evaluate joint displacements of the truss shown in fig.3.	**04**
	(c)	Determine member forces of the truss shown in fig.3.	**07**
Q.4	**(a)**	Define stiffness and flexibility.	**03**
	(b)	Determine member stiffness matrices of the plane frame shown in fig.4. Take EI = 60 kNm^2, EA = 3435 kN.	**04**
	(c)	Determine joint displacements and support reactions of the plane frame shown in fig.4. Take EI = 60 kNm^2, EA = 3435 kN.	**07**
Q.5	**(a)**	Write steps of finite element analysis.	**03**
	(b)	Derive shape functions of CST element using Cartesian coordinate.	**04**
	(c)	Using FEM, evaluate nodal displacements of the bar shown in fig.5. Take $E = 2 \times 10^5$ N/mm^2.	**07**
Q.6	**(a)**	Write displacement functions for 1D and 2D elements.	**03**
	(b)	Using FEM, evaluate nodal displacements of the beam shown in fig.6. Take EI = 60 kNm^2.	**04**
	(c)	Using FEM, evaluate nodal displacements and element stresses for the bar shown in fig.7. Take EA = 500 kN.	**07**
Q.7	**(a)**	Define plane stress and plane strain problems. Write constitutive matrices of plane stress and plane strain problems.	**05**
		OR	
Q.7	**(a)**	Derive nodal load vector for the 2-noded bar element subjected to surface traction 'T' per unit length.	**05**

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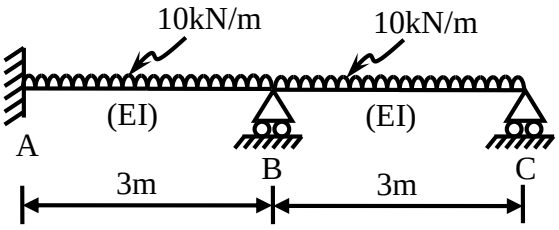

Fig. 1

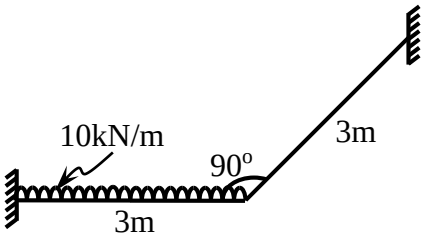

Fig. 2

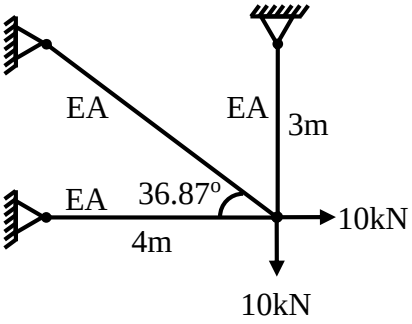

Fig. 3

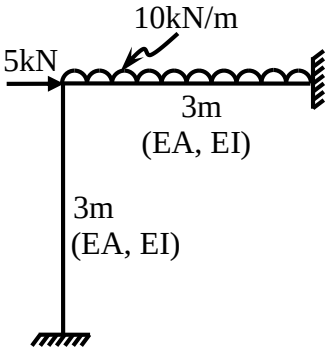

Fig. 4

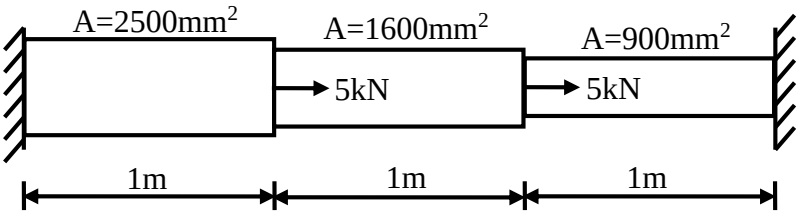

Fig. 5

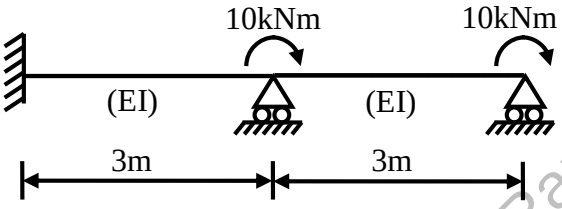

Fig. 6

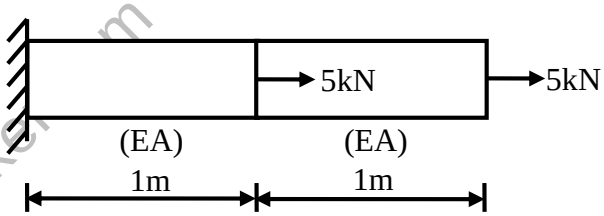

Fig. 7

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