

**GUJARAT TECHNOLOGICAL UNIVERSITY****ME - SEMESTER– I (New course)• REMEDIAL EXAMINATION – SUMMER 2015****Subject Code: 2712001****Date:13/05/2015****Subject Name: Matrix Methods of Structural Analysis****Time: 10:30 am to 1:00 pm****Total Marks: 70****Instructions:**

1. Take  $E = 2 \times 10^8 \text{ kN/m}^2$ ,  $I_z = I_y = 0.001 \text{ m}^4$ ,  $A_x = 0.01 \text{ m}^2$ ,  $I_x = 0.002 \text{ m}^4$  and  $G = 8 \times 10^7 \text{ kN/m}^2$  unless and otherwise given.
2. Attempt all questions.
3. Make suitable assumptions wherever necessary and mentioned it clearly.
4. Figures to the right indicate full marks.

- Q.1** (a) Obtain the rearranged joint stiffness matrix for the continuous beam shown in Figure 1. Flexural rigidity of all members is constant. **07**
- (b) Determine free joint displacements and support reactions for the continuous beam shown in Figure 1 using stiffness member approach. **07**

- Q.2** (a) Explain Non linear and linear response of a structure stating reasons of Non linearity. **07**
- (b) Elaborate basic principles of sub structuring and its advantages. **07**

**OR**

- (b) Derive rotation transformation matrix for a space truss member. **07**

- Q.3** (a) For the truss shown in Figure 2, obtain rearranged joint stiffness matrix taking advantage of symmetry. A is the cross-sectional area of member. **07**
- (b) Determine free joint displacements and support reactions for the truss shown in Figure 2 using stiffness member approach. **07**

**OR**

- Q.3** (a) Obtain assembled flexibility matrix for the truss shown in Figure 3. Cross sectional area of all members is A. **07**
- (b) Calculate member end-actions for the truss shown in Figure 3 using flexibility member approach. Tabulate the member forces. **07**

- Q.4** (a) Construct the rearranged joint stiffness matrix for the plane frame shown in Figure 4. **07**
- (b) Determine free joint displacements and support reactions for the plane frame shown in Figure 4 using stiffness member approach. **07**

**OR**

- Q.4** (a) Obtain assembled flexibility matrix for the plane frame shown in Figure 5. Flexural rigidity of all members is constant. **07**
- Q.4** (b) Calculate support reactions for the plane frame shown in Figure 5 using flexibility member approach. **07**

- Q.5** (a) Obtain the rearranged joint stiffness matrix of a composite structure shown in Figure 6. AB is a beam member with cross-section of 100 mm x 100 mm while BC is a truss member with 30 mm x 30 mm square cross section. Modulus of elasticity of beam and truss member is 20GPa and 200 GPa, respectively. **07**
- (b) Obtain load vector for the continuous beam shown in Figure 1, considering roller supports at B in place of elastic support, if (i) temperature of AB member is increased so that the top and bottom fibers are at 30 °C and 40 °C **07**

$^{\circ}\text{C}$ , respectively (ii) support A rotates counterclockwise by 0.01 radian and (iii) support C sinks by 3 mm. Assume depth of members as 100 mm and coefficient of thermal expansion as  $1.2 \times 10^{-6}$  per  $^{\circ}\text{C}$ .

OR

- Q.5** (a) Obtain the rearranged joint stiffness matrix for the grid shown in Figure 7. 07  
Flexural and torsional rigidity of all members are constant.  
(b) Determine free joint displacements and support reactions for the grid 07  
structure shown in Figure 7 using stiffness member approach.

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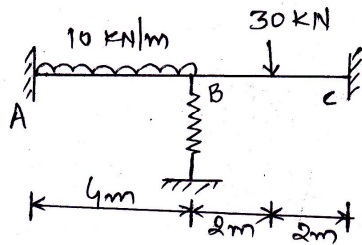


Fig. 1

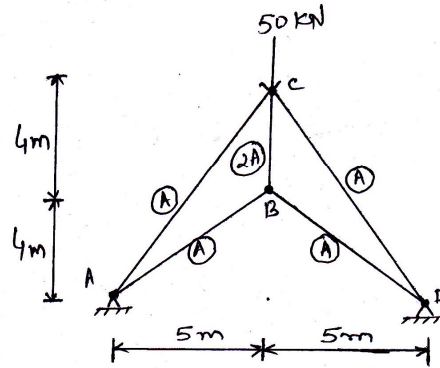


Fig. 2

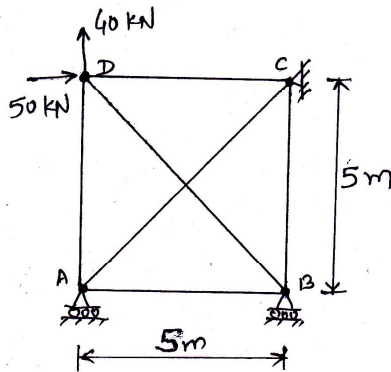


Fig. 3

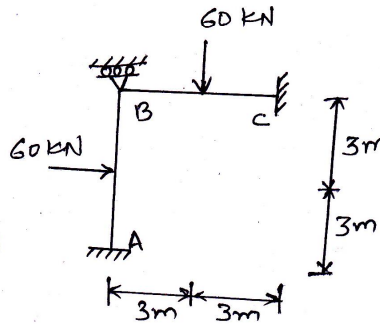


Fig. 4

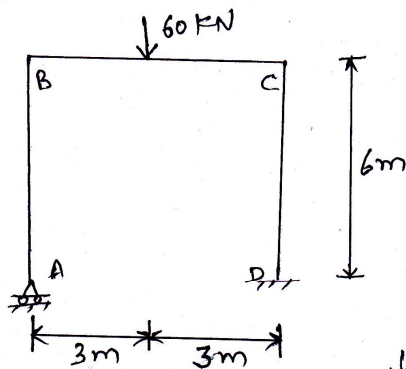


Fig. 5

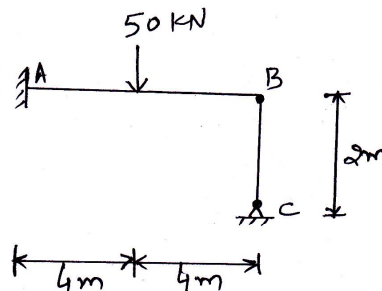


Fig. 6

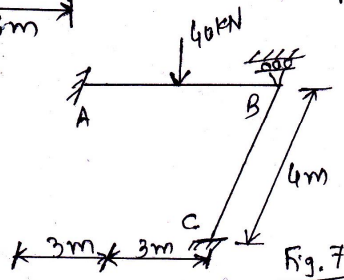


Fig. 7