1. Derive the flexibility matrix for the structures in Figure (a) to (e) with respect to the co-
shown ordinates.
1. Analyse the following problems using the direct flexibility method.

(a) A beam with a uniform load of 20 kN/m, supports at A and C, with a spring at D with stiffness $f = 9/EI$. The beam is 2m long.

(b) A cantilever beam with a load of 80 kN at B and a moment of 100 kN-m at C. The beam is 4m long.

(c) A beam with $EI = 10,000 \text{kN.m}^2$, supports at A and C, with a deflection of 15 mm at B. The beam is 3m long.

(d) A truss with a load of 60 kN at B and supports at A and C. The beam is 3m long.
1. Determine the horizontal and vertical displacement of joint C of the pin-jointed frame as shown in Figure 1 using generalized flexibility method. $AE=10^5$ kN for all members.

2. Determine the force in various members of the frame shown in Figure 2.

3. Determine the force in various members of the frame shown in Figure 3.

4. Determine the force in various members of the frame shown in Figure 4 if the member BD is short by 8 mm. Take $A=1100$ mm$^2$ and $E=150$ GPa for all members.

Figure 1.

Figure 2.

Figure 3.

Figure 4.
1. Analyse the uniform beam as shown in Figure 1 and draw the bending moment diagram using the generalized flexibility method.

2. Analyse the uniform beam if the joint A rotates by an angle \( \theta \) and support B settles downwards by an amount \( \Delta \) (refer Figure 2). Use generalized flexibility method.

3. Analyse the uniform beam as shown in Figure 3 using generalized flexibility method.

4. Find the force in the spring of the uniform beam as shown in Figure 4 using the generalized flexibility method.

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**Figure 1.**

![Uniform Beam with Load](image1)

**Figure 2.**

![Uniform Beam with Joint Rotation and Support Settlement](image2)

**Figure 3.**

![Uniform Beam with Load](image3)

**Figure 4.**

![Uniform Beam with Spring](image4)
1. Analyse the frames shown in Figures 1 to 3 and draw the bending moment diagram using the generalized flexibility method. $EI$ is constant for all members of the frame.

Figure 1.

Figure 2.

Figure 3.
1. Derive the stiffness matrix for the structures with respect to the co-ordinates as shown below.

(a) 

(b) 

(c) 

(d)
1. Analyze the beams as shown in Figures 1 and 2 by direct stiffness method.
2. Analyze the pin-jointed frame as shown in Figure 3 using the direct stiffness method.
3. Analyze the frame as shown in Figure 4 using the direct stiffness method.

Figure 1.

Figure 2.

Figure 3.

Figure 4.
4. Analyze the pin-jointed frame as shown in Figure 1 by using the generalized stiffness method if the member BD is short by 5mm and is forced in position.

5. Analyze the continuous beam as shown in Figure 2 using the generalized stiffness method.

6. Analyze the rigid-jointed frame as shown in Figure 3 by using the generalized stiffness method.

7. Analyze the rigid-jointed frame as shown in Figure 4 using the generalized stiffness method.

Figure 1.

Figure 2.

Figure 3.

Figure 4.
1. Write general computer programs for the analysis of (i) pin-jointed structures, (ii) continuous beams and (iii) right-jointed frames. Using above computer programs analyse the structures shown in Figure 1.

2. Also, analyze the above problems using any standard Structural Analysis Software.
1. Analyze the pin-jointed frame as shown in Figure 1 using the stiffness method if there is a rise of temperature by an amount of $\Delta T$ in all members. $AE$ is constant for all members.

2. Analyze the rigid-jointed frame as shown in Figure 2 using the stiffness method by both ignoring and considering the axial deformation. $EI$ is constant for all members.

3. Calculate the slope at $A$, $B$ and $C$ and deflection at $B$ for the beam as shown in Figure 3 by transfer matrix method.

4. Analyze the continuous beam as shown in Figure 4 by transfer matrix method, if support $A$ rotates by an angle $\theta$ and support $B$ settles by an amount of $\Delta$.

5. Analyze the fixed beam as shown in Figure 5 by transfer matrix method.

6. Analyze the continuous beam as shown in Figure 6 by transfer matrix method.