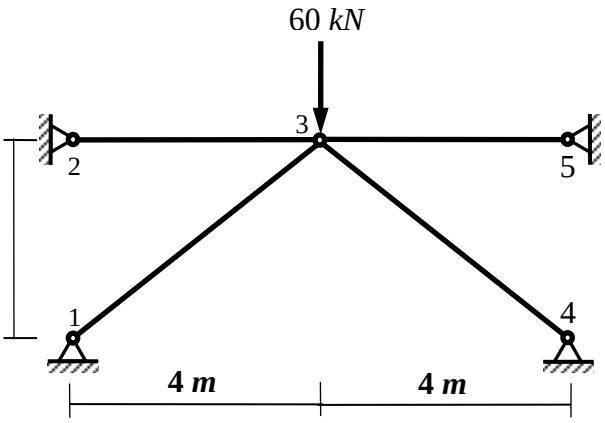
Ministry of Higher Education	Academic Year :	**2016/2017**
Giza Higher Institute for Eng. & Tech.	Semester :	**Second**
Civil Engineering Department	Level :	**4th**
Course Name: **Computer Applications in Civil Eng.**	Time :	**3 Hours**
Course Code : **CIV 410** Date : **24 / 5 / 2017**	Examiner:	***Dr. M. Abdel-Kader***
Final Term Exam		
Total Marks: **60**	No. of Questions:	**3**

Question (1): (20 Marks)

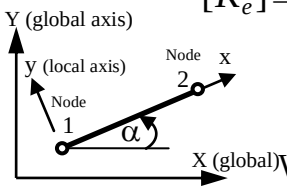
For the shown truss, **using the stiffness method**, determine the vertical displacement at node 3 and the reactions at the supports due to the given load.



Given Data:

$E = 2.0\times10^{7}\ kN/m^2$ and $A = 5.0\times10^{-4}\ m^2$

$$[K_e]=\begin{bmatrix} \frac{EA}{L}\lambda^2 & \frac{EA}{L}\mu\lambda & -\frac{EA}{L}\lambda^2 & -\frac{EA}{L}\mu\lambda \\ \frac{EA}{L}\mu\lambda & \frac{EA}{L}\mu^2 & -\frac{EA}{L}\mu\lambda & -\frac{EA}{L}\mu^2 \\ -\frac{EA}{L}\lambda^2 & -\frac{EA}{L}\mu\lambda & \frac{EA}{L}\lambda^2 & \frac{EA}{L}\mu\lambda \\ -\frac{EA}{L}\mu\lambda & -\frac{EA}{L}\mu^2 & \frac{EA}{L}\mu\lambda & \frac{EA}{L}\mu^2 \end{bmatrix}$$



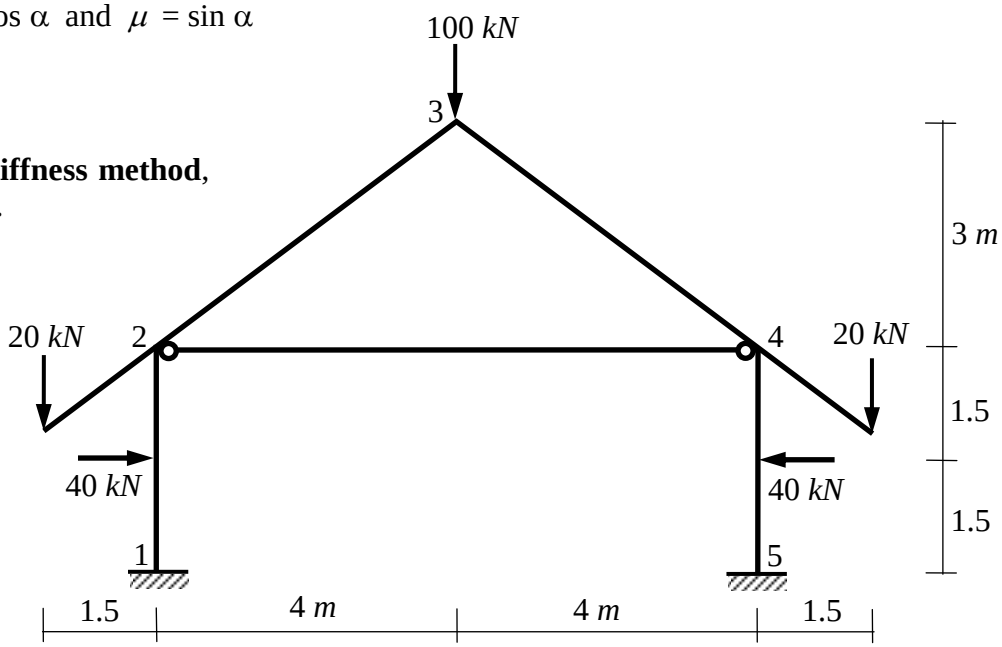
Where, $\lambda = \cos\alpha$ and $\mu = \sin\alpha$

Truss (Bar) element

Question (2): (20 Marks)

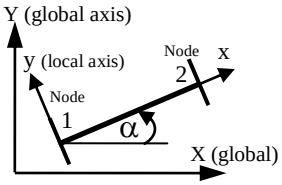
For the shown frame, **using the stiffness method**, draw the bending moment diagram.

Neglect axial deformation.



Given Data:

E, I and *A* are constants



Frame element

$$[K_e]=\left[\begin{array}{cccc:cccc} \left(\frac{EA}{L}\lambda^2+\frac{12EI}{L^3}\mu^2\right) & \left(\frac{EA}{L}\mu\lambda-\frac{12EI}{L^3}\mu\lambda\right) & -\frac{6EI}{L^2}\mu & \left(-\frac{EA}{L}\lambda^2-\frac{12EI}{L^3}\mu^2\right) & \left(-\frac{EA}{L}\mu\lambda+\frac{12EI}{L^3}\mu\lambda\right) & -\frac{6EI}{L^2}\mu \\ \left(\frac{EA}{L}\mu\lambda-\frac{12EI}{L^3}\mu\lambda\right) & \left(\frac{EA}{L}\mu^2+\frac{12EI}{L^3}\lambda^2\right) & \frac{6EI}{L^2}\lambda & \left(-\frac{EA}{L}\mu\lambda+\frac{12EI}{L^3}\mu\lambda\right) & \left(-\frac{EA}{L}\mu^2-\frac{12EI}{L^3}\lambda^2\right) & \frac{6EI}{L^2}\lambda \\ -\frac{6EI}{L^2}\mu & \frac{6EI}{L^2}\lambda & \frac{4EI}{L} & \frac{6EI}{L^2}\mu & -\frac{6EI}{L^2}\lambda & \frac{2EI}{L} \\ \hdashline \left(-\frac{EA}{L}\lambda^2-\frac{12EI}{L^3}\mu^2\right) & \left(-\frac{EA}{L}\mu\lambda+\frac{12EI}{L^3}\mu\lambda\right) & \frac{6EI}{L^2}\mu & \left(\frac{EA}{L}\lambda^2+\frac{12EI}{L^3}\mu^2\right) & \left(\frac{EA}{L}\mu\lambda-\frac{12EI}{L^3}\mu\lambda\right) & \frac{6EI}{L^2}\mu \\ \left(-\frac{EA}{L}\mu\lambda+\frac{12EI}{L^3}\mu\lambda\right) & \left(-\frac{EA}{L}\mu^2-\frac{12EI}{L^3}\lambda^2\right) & -\frac{6EI}{L^2}\lambda & \left(\frac{EA}{L}\mu\lambda-\frac{12EI}{L^3}\mu\lambda\right) & \left(\frac{EA}{L}\mu^2+\frac{12EI}{L^3}\lambda^2\right) & -\frac{6EI}{L^2}\lambda \\ -\frac{6EI}{L^2}\mu & \frac{6EI}{L^2}\lambda & \frac{2EI}{L} & \frac{6EI}{L^2}\mu & -\frac{6EI}{L^2}\lambda & \frac{4EI}{L} \end{array}\right]$$

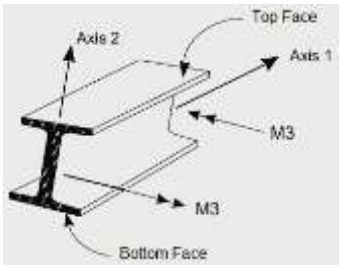
Where, $\lambda = \cos\alpha$ and $\mu = \sin\alpha$

Please turn over

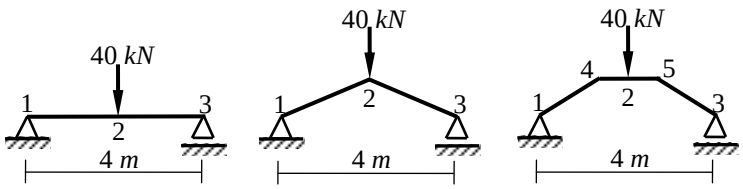
Question (3): (20 Marks)

TRUE or FALSE (Put ✓ or ✗ in front of the statement number in your answer sheet)

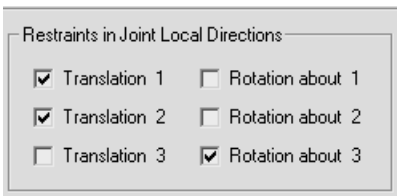
1. The abbreviation "CAD" means "Computer Aided Design" and the abbreviation "SAP" means "Structural Analysis Programs".
2. The abbreviation "DOF" means Degree of Freedom.
3. The frame element is also called beam-column element.
4. Bar (Truss) element, Beam element and frame element are 1D elements.
5. Bar element used in modeling trusses has two nodes at its ends, every node has 1 DOF in the element axial direction.
6. In space frames, there are 6 DOF per free node, which are 3 translations and 3 rotations.
7. The default initial output of SAP2000 is the deformed shape of the structure.
8. If the direction of the moment M3 is as shown in the figure, the top face will be subject to a tension.



9. Structures that can be modeled with the frame element include: 3-D and planar frames – 3-D and planar trusses – Flat slabs – Raft foundation.
10. The order of the input data: Editing Supports & Assigning Frame Sections is very important.
11. Settlement of support, change in temperature and tolerance problems (fabrication errors) cause stresses in statically determinate structures, but not in statically indeterminate structures.
12. For **linear elastic** materials, stresses are linearly proportional to strains as described by **Hooke's Law**
13. **Isotropic** means that the material properties are independent of the coordinates.
14. **Homogeneous** means that the material properties are independent of the rotation of the axes at any point in the body or structure.
15. **Seismic (Earthquake) load** is usually applied vertically on the structure.
16. **Wind load** is usually applied parallel to the surface.
17. The bending moments at mid-span (at node 2) of the three beams shown below are the same (= 40 *kN.m*).



18. In the three beams shown above, when the axial deformation is neglected, $u_3 = 0$ for all.
19. Stiffness is the property of an element which is defined as displacement per unit force.
20. For plane frame in X-Z plane, the fixed support has restraints in Joint Local Directions as shown.



With my best wishes

Dr. M. Abdel-Kader