Ministry of Higher Education
Giza Higher Institute of Engineering & Technology
Civil Engineering Department
Course Name: **Computer Applications in Civil Eng.**
Course Code: **CIV 325** Date: **1 / 7 / 2021**

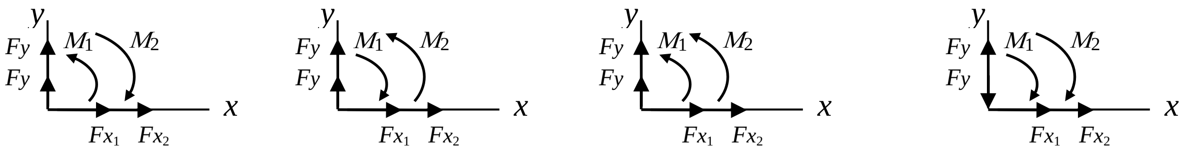
Academic Year: **2020/2021**
Semester: **Second**
Level: **3rd Civil**
Time: 3 **Hours**
Examiner**:** ***Dr. M. Abdel-Kader***

Final Exam

Total Marks**: 75** No. of Questions**: 50** (Attempt all questions)

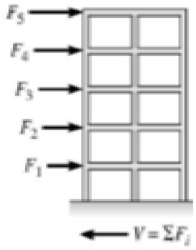
Choose the nearest answer. **(a2, a5, b1, b7, c1, c6)**

1. Stiffness is the property of an element which is defined as:
   (A) Displacement per unit area. (B) Displacement per unit force. (C) Force per unit force.
   (D) Force per unit displacement.
2. For plane frame element 1-2 (connecting joints 1 and 2), the positive sign of forces (forces and moments) is:

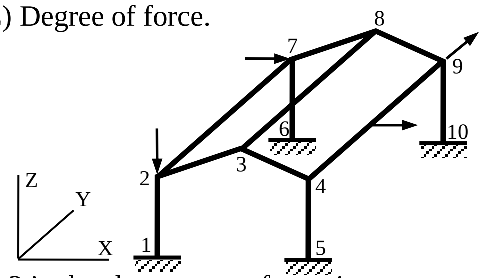


(A) (B) (C) (D)

3. One of the assumptions that the stiffness method is based on to analyze plane frames is:
   (A) Members will behave in non-linear and plastic manner.
   (B) Members (beams and columns) are straight with constant properties between joints.
   (C) Applied loads will act out of the structure plane.
4. In SAP, loads and properties of material are:
   (A) Fixed data. (B) Output data. (C) Input data. (D) Results of the analysis.
5. In SAP, the .... must be defined for (1D) plane frame elements.
   (A) Areas (B) Thicknesses (C) Sections (D) Colors



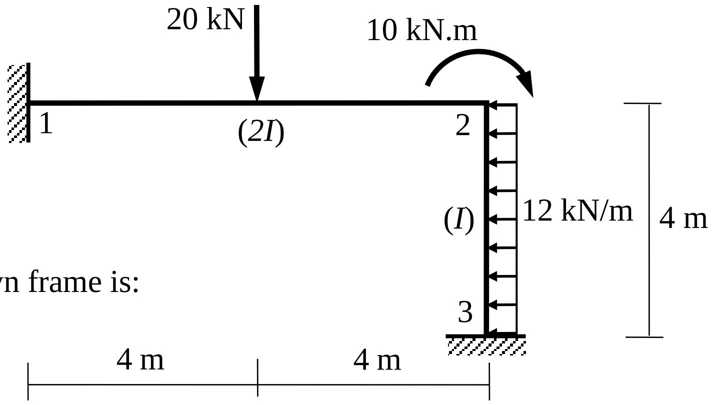
6. The horizontal forces applied on the shown frame is called .... load.
   (A) Earth pressure (B) Earthquake (C) Settlement (D) Hydrostatic
7. In SAP, the internal forces are:
   (A) Fixed data. (B) Input data. (C) Given data. (D) Output data.
8. In SAP, self-weight loading always acts in the … direction.
   (A) X (B) Y (C) –Y (D) –Z
9. Wind load applied over the height of high-rise buildings is assumed:
   (A) Constant. (B) 1000 kN/m. (C) Perpendicular to the surface. (D) Parallel to the surface.
10. When the material properties are independent of the coordinates, the material is:
    (A) Isotropic. (B) Non-linear. (C) Plastic. (D) Homogeneous.
11. The responsibility of the analytical model results lies on:
    (A) The company developed the software. (B) The structural designer who developed the software.
    (C) The structural designer who used the software. (D) The computer used.
12. The abbreviation "CAD" means:
    (A) Common Analysis Data. (B) Computer-Aided Design. (C) Calculation And Design. (D) Computer And Data.
13. The abbreviation "DOF" means:
    (A) Possible translations at nodes. (B) Possible rotations at nodes. (C) Degree of force.
    (D) Possible translations and rotations at nodes.



14. The number of non-zero DOF for the shown space frame is:
    (A) 60 (B) 30 (C) 36 (D) 18
15. The number of non-zero DOF per node 1 in the shown space frame is:
    (A) Zero (B) 6 (C) 2 (D) 3
16. The number of non-zero DOF per node 2 in the shown space frame is:
    (A) Zero (B) 3 (C) 4 (D) 6
17. If the axial deformation is neglected, the number of non-zero DOF per node 2 in the shown space frame is:
    (A) 4 (B) 3 (C) 5 (D) 2
18. When there are loads between the nodes, the equilibrium equation of a plane frame is $\{F\} = [K]\{\Delta\}+\{F^f\}$ where;
    (A) $\{F\}$ is the nodal forces. (B) $\{F^f\}$ is the nodal displacements. (C) $[F^f]$ is the element stiffness matrix.
    (D) $\{\Delta\}$ is the nodal forces.
19. In 2D Analysis, ... can be used.
    (A) only 2D elements. (B) 1D, 2D and 3D elements. (C) 2D and 3D elements (D) 1D and 2D elements.
20. Structures that cannot be modeled with the frame element are:
    (A) Space frames. (B) Space trusses. (C) Flat slabs. (D) Plane frames.

Please turn over

For the shown loaded plane frame with variable moment of inertia, use **the stiffness method** and **neglect axial deformation:**



Choose the nearest answer. (b1, b7, c1, c6)

21. The shown frame has … nodes.
    (A) 1 (B) 2 (C) 3 (D) 4

22. The least number of elements to be taken for the shown frame is:
    (A) 1 (B) 2 (C) 3 (D) 4

23. By neglecting axial deformation**,** the number of the non-zero DOF for the shown frame becomes:
    (A) Zero (B) 1 (C) 2 (D) 3

24. The terms (coefficients) of the force vector $\{F\}$of the shown frame are:
    (A) X_1, Y_1, M_1, 0, 0, -10, X_3, Y_3, M_3 (B) X_1, Y_1, M_1, 0, 20, 0, X_3, Y_3, M_3 (C) X_1, Y_1, -20, 10, 20, 0, X_3, Y_3, M_1

25. The terms (coefficients) of the displacement vector $\{\Delta\}$ of the shown frame are:
    (A) 0, 0, 0, u_2, v_2, θ_2, 0, 0, 0 (B) 0, 0, 0, 0, 0, θ_2, 0, 0, 0 (C) 0, 0, 0, θ_2, 0, 0 (D) 0, 0, θ_1, 0, 0, θ_2, 0, 0, θ_3

26. The terms (coefficients) of the fixed end solution of element 1 (nodes 1 & 2) are:
    (A) 0, 10, 20, 0, 10, -20 (B) 0, 20, 10, 20, 10, -20 (C) 10, 0, 20, 10, 0, -20 (D) 0, 0, 20, 0, 0, -20

27. The properties of element 1 (nodes 1 & 2) are.
    (A) $\alpha = 0$, $\lambda = 1$, $\mu = 0$ and L=8 m (B) $\alpha = 0$, $\lambda = 1$, $\mu = 0$ and L=4 m (C) $\alpha = 0$, $\lambda = 0$, $\mu = 1$ and L=8 m

28. The terms (coefficients) of the sixth column of the stiffness matrix of element 1 $[K^1]$ are:
    (A) 0, 3*EI*/16, *EI*/2, 0, -3*EI*/16, *EI* (B) 0, 0, *EI*/2, 0, -3*EI*/6, *EI* (C) 0, 0, *EI*/2, 0, -3*EI*, *EI*

29. The rotation angle θ_2 at node 2 is:
    (A) -800/*EI* (B) -30/2*EI* (C) -3/*EI* (D) -40/3*EI*

30. The final bending moment at node 1 is:
    (A) -1.5 kN.m (B) 8.0 kN.m (C) -72.5 kN.m (D) -18.5 kN.m

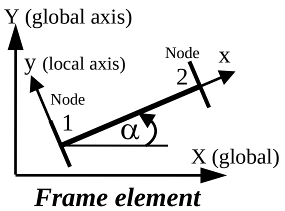
31. The final bending moments at node 2 are:
    (A) 40 and 30 kN.m (B) -7 and -20 kN.m (C) -3 and -13 kN.m (D) -23 and -13 kN.m

32. The final bending moment at node 3 is:
    (A) -17.5 kN.m (B) -17.5 kN.cm (C) -17.5 N.m (D) -17.5 N.mm

33. The final bending moment at the middle of element 1 (nodes 1 & 2) is:
    (A) 80.2 kN.m (B) 70.6 kN.m (C) 19.25 kN.m (D) 2.25 kN.m

34. The final bending moment at the middle of element 2 (nodes 2 & 3) is:
    (A) zero (B) 70.6 kN.m (C) 18.5 kN.m (D) 8.75 kN.m

35. The final vertical reaction at node 1 is:
    (A) 20.7 kN (B) 9.4 kN (C) 0.5 kN (D) 80.5 kN

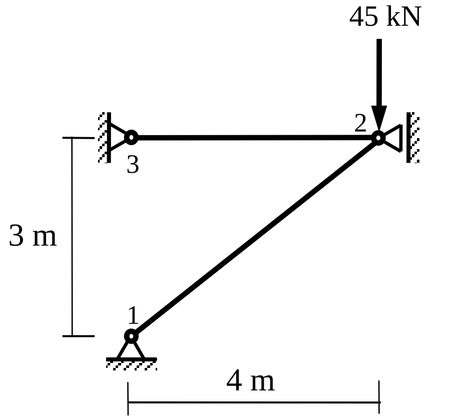


Frame element

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

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

For the shown loaded truss, use **the stiffness method**



<u>Given Data:</u>

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

Choose the nearest answer. (b1, b7, c1, c6)

36. The number of the non-zero DOF for the shown truss is:
(A) Zero (B) 1 (C) 2 (D) 3

37. The terms (coefficients) of the force vector $\{F\}$of the shown frame are:
(A) $X_1, Y_1, X_2, -45, X_3, Y_3$ (B) $X_1, Y_1, 0, 0, X_3, Y_3$ (C) $X_1, Y_1, -54, X_2, X_3, Y_3$ (D) $X_1, Y_1, M_1, X_2, -45, X_3, Y_3, M_3$

38. The terms (coefficients) of the displacement vector of element 1 (nodes 1 & 2) are:
(A) $0, 0, 0, v_2, 0, v_3$ (B) $0, v_1, 0, v_2$ (C) 0, 0, 0, 0 (D) $0, 0, 0, v_2$

39. The terms (coefficients) of the displacement vector of element 2 (nodes 2 & 3) are:
(A) $0, v_2, 0, 0$ (B) $0, 0, v_2, 0, 0, 0$ (C) $0, v_2, 0, 0, v_2$ (D) $0, v_1, 0, v_2$

40. The terms (coefficients) of the displacement vector $\{\Delta\}$ of the shown truss are:
(A) $0, -45, 0, v_2, 0, 0, 0$ (B) $10, v_1, 0, v_2, 10, 0$ (C) $0, 0, 0, v_2, 0, 0$ (D) $0, 0, 0, v_2, 0, 0, v_2, 0$

41. The terms (coefficients) of the fixed end solution $\{F^{f}\}$ of the shown truss are:
(A) 0, 0, -45, 0, 0, 0 (B) 0, 0, -45, 0, 0, 0 (C) $X_1, Y_1, 0, -45, 0, 0$ (D) There is no $\{F^{f}\}$ in truss

42. The properties of element 1 (nodes 1 & 2) are.
(A) $\lambda = 0.8$, $\mu = 0.6$, L=3 m (B) $\lambda = 0.8$, $\mu = 0.6$, L=5 m (C) $\lambda = 0.8$, $\mu = 0.6$, L=4 m (D) $\lambda = 0.8$, $\mu = 0$, L=5 m

43. The properties of element 2 (nodes 2 & 3) are.
(A) $\lambda = -1$, $\mu = 0$, L=3 m (B) $\lambda = -1$, $\mu = 0$, L=5 m (C) $\lambda = -1$, $\mu = 0$, L=4 m (D) $\lambda = -1$, $\mu = 0.8$, L=3 m

44. The terms (coefficients) of the fourth column of the stiffness matrix of element 1 (nodes 1 & 2) $[K^1]$ are:
(A) -960, -720, 960, 720 (B) -960, -720, 0, 0 (C) 0, 0, 960, 720 (D) -960, 0, 0, 720

45. The terms (coefficients) of the second column of the stiffness matrix of element 2 (nodes 2 & 3) $[K^2]$ are:
(A) -960, -720, 960, 720 (B) 0, 0, 960, 720 (C) -960, -720, 0, 0 (D) 0, 0, 0, 0

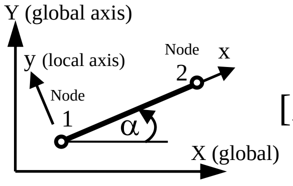
46. The displacement v_2 at node 2 is:
(A) 5.0 mm ↓ (B) 62.5 mm ↓ (C) 16.3 mm ↓ (D) zero

47. The value of the horizontal reaction at node 1 is:
(A) zero (B) 60 kN (C) 45 kN (D) 22.5 kN

48. The values of the vertical reaction at node 1 is:
(A) 60 kN (B) 45 kN (C) zero (D) 22.5 kN

49. The value of the horizontal reaction at node 2 is:
(A) zero (B) 60 kN (C) 45 kN (D) 22.5 kN

50. The value of the horizontal reaction at node 3 is:
(A) 60 kN (B) 45 kN (C) 22.5 kN (D) zero



Truss (Bar) element

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

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

With my best wishes

Dr. M. Abdel-Kader