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: **7 / 6 / 2022**

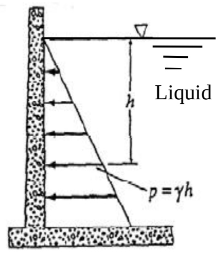
Academic Year: **2021/2022**
Semester: **Second**
Level: **3rd Civil**
Time: 3 **Hours**
Examiner: ***Dr. M. Abdel-Kader***

Final Exam

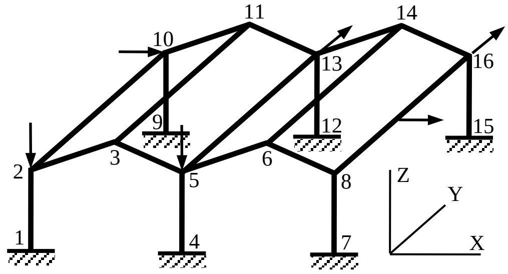
Total Marks: **75** No. of Questions: **50** (Attempt all questions)

Choose the nearest answer.

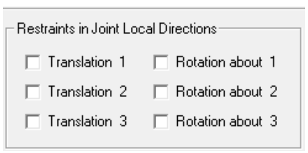
1. The responsibility of the analytical model results lies on:
   (A) The company developed the software. (B) The input data.
   (C) The structural designer who used the software. (D) The computer used.
2. The abbreviation "CAD" means:
   (A) Common Analysis Data. (B) Computer-Aided Design. (C) Calculation And Design. (D) Computer And Data.
3. 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.
4. Stiffness is the property of an element which is defined as:
   (A) Displacement per unit area. (B) Force per unit displacement. (C) Force per unit mass.
   (D) Displacement per unit force.
5. One of the assumptions that the stiffness method is based on to analyze plane frames is:
   (A) Members will behave in linear and elastic manner.
   (B) Members (beams and columns) are straight with variable properties between nodes.
   (C) Axial forces in members are very much higher than the respective Euler buckling loads.
   (D) Applied loads will act out of the structure plane.
6. In SAP, loads and properties of material are:
   (A) Fixed data. (B) Output data. (C) Input data. (D) Results of the analysis.
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. In SAP, the ………. must be defined for (1D) plane frame elements.
   (A) Areas (B) Thicknesses (C) Sections (D) Colors
10. The triangle load applied on the shown vertical wall is called ………. load.
    (A) Earth pressure (B) Earthquake (C) Settlement (D) Hydrostatic



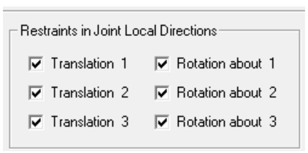
11. Wind load applied over the height of high-rise buildings is assumed:
    (A) Constant. (B) 1000 kN/m. (C) Perpendicular to the surface. (D) Parallel to the surface.
12. When the material properties are independent of the coordinates, the material is:
    (A) Homogeneous. (B) Non-linear. (C) Plastic. (D) Isotropic.
13. When the material properties are independent of the rotation of the axes at any point, the material is:
    (A) Homogeneous. (B) Non-linear. (C) Plastic. (D) Isotropic.
14. 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 fixed end solution. (B) $\{F^f\}$ is the nodal displacements. (C) $[K]$ is the element stiffness matrix.
    (D) $\{\Delta\}$ is the nodal forces.
15. In 2D Analysis, ………………. can be used.
    (A) only 2D elements. (B) 1D and 2D elements. (C) 2D and 3D elements (D) 1D, 2D and 3D elements.
16. The number of DOF per node in a plane frame is:
    (A) 2 (B) 3 (C) 6 (D) 12
17. The number of DOF per node in a space frame is:
    (A) 2 (B) 3 (C) 6 (D) 12
18. The number of non-zero DOF for the shown space frame is:
    (A) 30 (B) 48 (C) 60 (D) 96
19. The number of non-zero DOF per node 7 in the shown space frame is:
    (A) Zero (B) 3 (C) 4 (D) 6



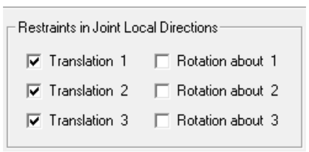
20. The roller support has restraints in Joint Local Directions as:



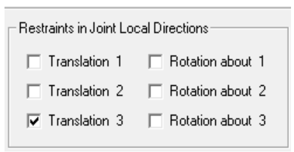
(A)



(B)



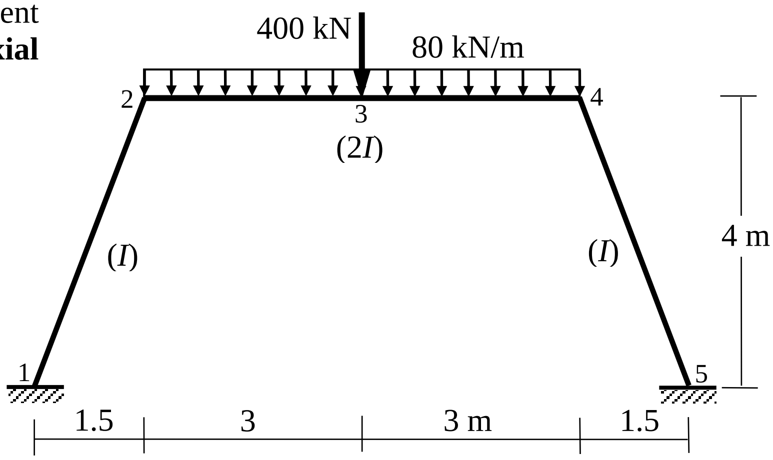
(C)



(D)

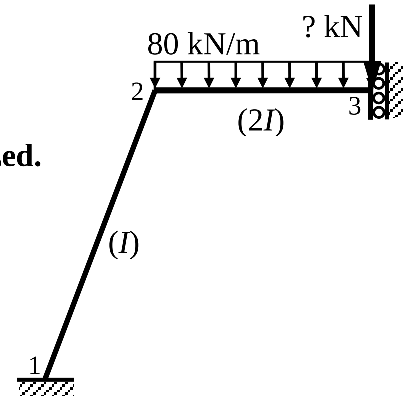
Please turn over

For the shown loaded plane frame with variable moment of inertia, use **the stiffness method** and **neglect axial deformation.**
Note that E and A are constants, and the relative moments of inertia are given between brackets.



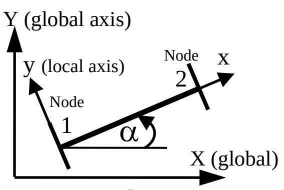
Choose the nearest answer.

21. The shown frame has … nodes.
(A) 2 (B) 3 (C) 4 (D) 5
22. The shown frame has … elements.
(A) 2 (B) 3 (C) 4 (D) 5
23. In general, the least number of elements to be taken for the shown frame is:
(A) 1 (B) 2 (C) 3 (D) 5
24. Because of symmetry about a vertical line, the least number of elements to be taken for the shown frame is:
(A) 1 (B) 2 (C) 3 (D) 4



Due to symmetry, only one half of the frame, as shown, will be analyzed.

25. By neglecting axial deformation**,** the number of non-zero DOF for half of the frame becomes:
(A) Zero (B) 1 (C) 2 (D) 3
26. The properties of element 1 (nodes 1 & 2) are.
(A) $\lambda = 0$, $\mu = 1$, L=4 m (B) $\lambda = 0.35$, $\mu = 0.94$, L=4.27 m
(C) $\lambda = 0.8$, $\mu = 0.6$, L=5 m (D) $\lambda = 1$, $\mu = 0$, L=4.27 m
27. The properties of element 2 (nodes 2 & 3) are.
(A) $\lambda = 1$, $\mu = 0$, L=3 m (B) $\lambda = 0.35$, $\mu = 0.94$, L=3 m (C) $\lambda = 0$, $\mu = 1$, L=3 m (D) $\lambda = 1$, $\mu = 0$, L= 6 m
28. The terms (coefficients) of the force vector $\{F\}$of the shown half of the frame are:
(A) X_1, Y_1, M_1, 0, 0, 0, X_3, -400, M_3 (B) X_1, Y_1, M_1, 0, 0, 0, X_3, -200, M_3 (C) X_1, Y_1, M_1, 0, 80, 0, X_3, -200, 0
29. The terms (coefficients) of the displacement vector $\{\Delta\}$ of the shown half of the frame are:
(A) 0, 0, 0, 0, v_2, θ_2, 0, 0, 0 (B) 0, 0, 0, 0, 0, θ_2, 0, v_3, 0 (C) 0, 0, 0, θ_2, 0, 0 (D) 0, 0, 0, 0, 0, θ_2, 0, 0, θ_3
30. The terms (coefficients) of the fixed end solution $\{F^f\}$of element 1 (nodes 1 & 2) are:
(A) 0, 0, 80, 0, 0, -80 (B) 0, 0, 0, 0, 0, 0 (C) 0, 0, 0, 80, 0, 0 (D) 0, 80, 60, 0, 20, -60
31. The terms (coefficients) of the fixed end solution $\{F^f\}$of element 2 (nodes 2 & 3) are:
(B) 0, 20, 60, 0, 20, -60 (B) 0, 20, 10, 0, 20, -10 (C) 0, 60, 120, 60, 0, -120 (D) 0, 120, 60, 0, 120, -60
32. The rotation angle θ_2 at node 2 is:
(A) -80/EI (B) -30/2EI (C) -337/EI (D) -10/3EI
33. The final bending moment at node 1 is:
(A) -1.5 kN.m (B) 8 kN.m (C) -72 kN.m (D) -158 kN.m
34. The value of the final bending moment at node 2 is:
(A) 230 kN.m (B) 315 kN.m (C) 13 kN.m (D) 115 kN.m
35. The final bending moment at node 3 is:
(A) 645 kN.m (B) 325 kN.cm (C) 460 N.m (D) zero



Frame element

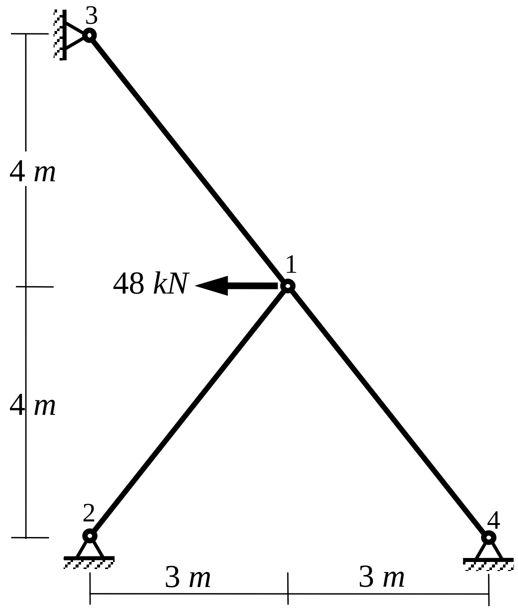
$$[K_e] = \begin{bmatrix} \left(\frac{EA}{L}\lambda^2 + \frac{12EI}{L^3}\mu^2\right) & \left(\frac{EA}{L}\mu\lambda - \frac{12EI}{L^3}\mu\lambda\right) & -\frac{6EI}{L^2}\mu & \left(-\frac{EA}{L}\lambda^2 - \frac{12EI}{L^3}\mu^2\right) & \left(-\frac{EA}{L}\mu\lambda + \frac{12EI}{L^3}\mu\lambda\right)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

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

Please turn over

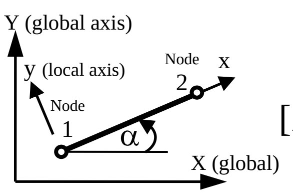
For the shown loaded truss, use **the stiffness method.**

EA is constant for all members.



Choose the nearest answer.

36. The number of the non-zero DOF for the shown truss is:
    (A) 1 (B) 2 (C) 3 (D) 8
37. The terms (coefficients) of the force vector $\{F\}$at node 1 are:
    (A) 0, 0, -48 (B) -48, 0 (C) 48, 0, 0 (D) 0, -48, 0
38. The terms (coefficients) of the force vector $\{F\}$at node 2 are:
    (A) X, Y (B) X_1, Y_1 (C) X_2, Y_2 (D) X_2, Y_2, 0
39. The terms (coefficients) of the fixed end solution $\{F^f\}$ at node 2 are:
    (A) 0, 0, 0 (B) 0, 0 (C) -48, 0 (D) There is no $\{F^f\}$ in truss
40. The terms (coefficients) of the displacement vector of element 1 (nodes 1 & 2) are:
    (A) 0, 0, u_2, v_2 (B) 0, v_1, 0, v_2 (C) u_1, v_1, 0, 0, 0, 0 (D) u_1, v_1, 0, 0
41. The terms (coefficients) of the displacement vector of element 2 (nodes 1 & 3) are:
    (A) 0, 0, u_3, v_3 (B) 0, v_1, 0, v_2 (C) u_3, v_3, 0, 0, 0, 0 (D) u_1, v_1, 0, 0
42. The terms (coefficients) of the displacement vector $\{\Delta\}$ of the shown truss are:
    (A) 0, 0, u_2, v_2, 0, 0, 0, 0 (B) 0, v_1, 0, v_2, 0, 0, 0, 0 (C) u_1, v_1, 0, 0, 0, 0, 0, 0 (D) 0, 0, 0, v_2, 0, 0, u_2, 0
43. The properties of element 1 (nodes 1 & 2) are.
    (A) $\lambda = 0.8$, $\mu = 0.6$, L=3 m (B) $\lambda = -0.6$, $\mu = -0.8$, L=5 m (C) $\lambda = 0.8$, $\mu = 0.6$, L=4 m (D) $\lambda = 0.8$, $\mu = 0$, L=5 m
44. The properties of element 2 (nodes 1 & 3) are.
    (A) $\lambda = -1$, $\mu = 0$, L=3 m (B) $\lambda = -1$, $\mu = 0$, L=5 m (C) $\lambda = -0.6$, $\mu = 0.8$, L=5 m (D) $\lambda = -1$, $\mu = 0.8$, L=3 m
45. The displacement u_1 at node 1 is:
    (A) 20/*EI* ← (B) 250/*EA* ← (C) 20/*EA* ← (D) zero
46. The displacement v_1 at node 1 is:
    (A) 119/*EA* ↓ (B) 62.5/*EA* ↓ (C) 23/*EA* ↓ (D) zero
47. The value of the horizontal reaction at node 2 is:
    (A) zero (B) 24 kN (C) 48 kN (D) 36 kN
48. The value of the horizontal reaction at node 3 is:
    (A) 36 kN (B) 32 kN (C) 24 kN (D) 12 kN
49. The value of the vertical reaction at node 3 is:
    (A) 28 kN (B) 32 kN (C) 24 kN (D) 16 kN
50. The value of the vertical reaction at node 4 is:
    (A) 28 kN (B) zero (C) 36 kN (D) 16 kN



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