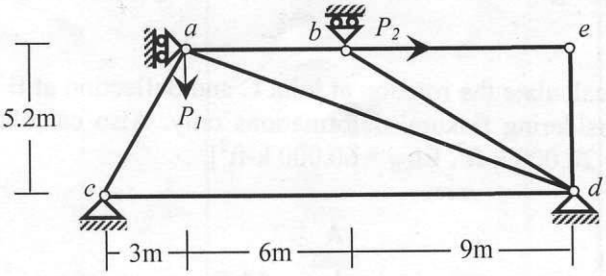
University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2012
Program: B. Sc. Engineering (Civil)

Course Title: Structural Engineering III — Credit Hours: 3.0 — Course Code: CE 411
Time: 3 hours — Full Marks: 90 (= 10 × 9)

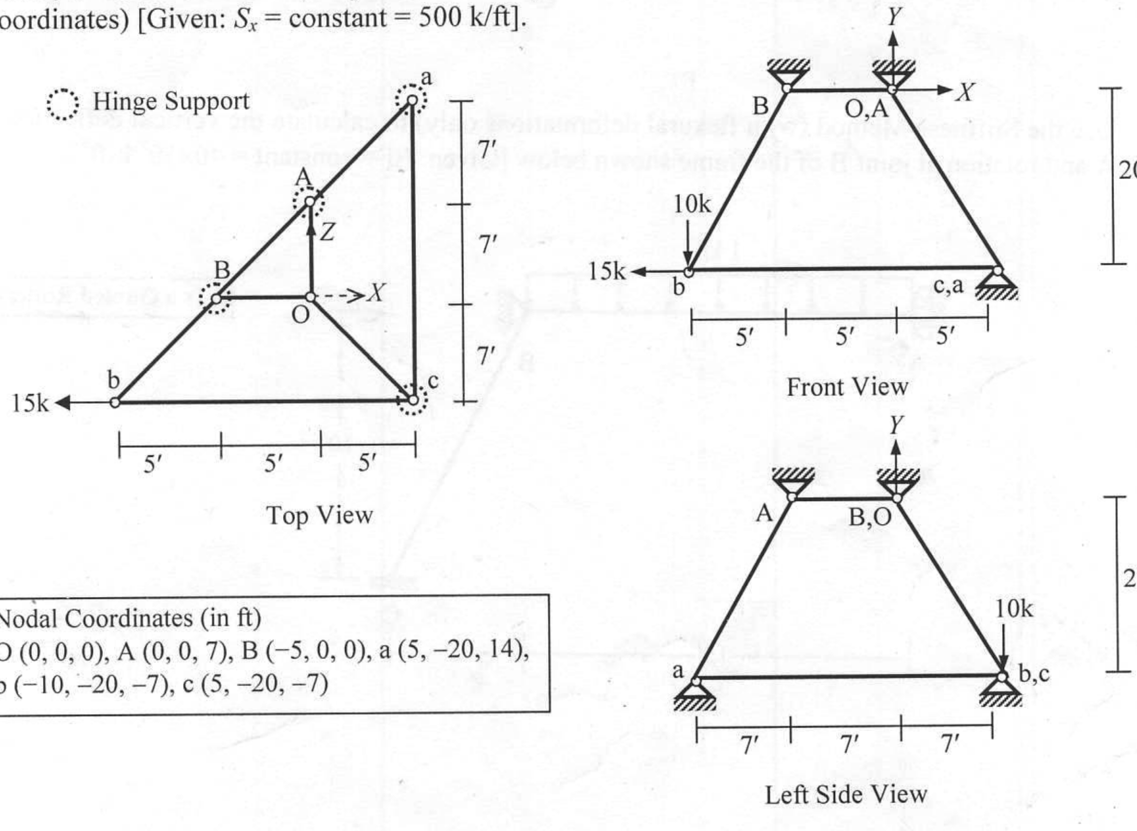
[Answer **any 09 (nine)** of the following 12 questions]

1. For the truss shown below, ignore the zero-force members and formulate the stiffness matrix, load vector and write down the boundary conditions [Given: EA/L = constant = 1000 kip/ft].



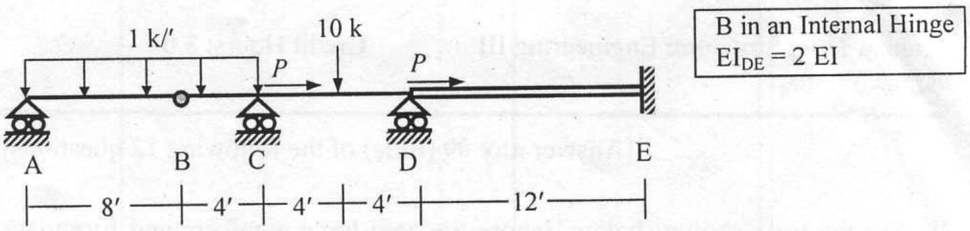
2. For the truss described in Question 1, the joint *a* deflects 0.15' downwards and *b* deflects 0.10' rightward. Calculate the (i) forces in all the members, (ii) applied loads P_1 and P_2.

3. Ignoring zero-force members, formulate the stiffness matrix, load vector and calculate the deflections (in *X*-, *Y*- and *Z*-directions) at joint b of the space truss OABabc loaded as shown below (with nodal coordinates) [Given: S_x = constant = 500 k/ft].



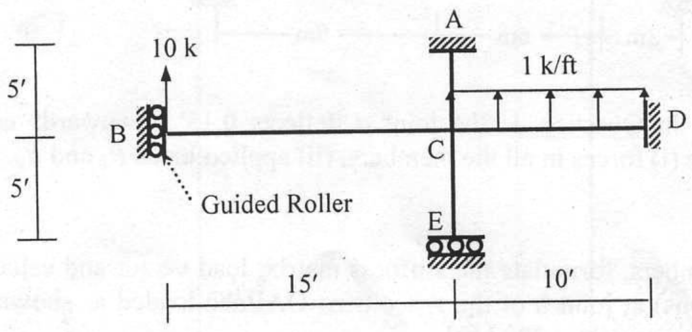
Nodal Coordinates (in ft)
O (0, 0, 0), A (0, 0, 7), B (−5, 0, 0), a (5, −20, 14), b (−10, −20, −7), c (5, −20, −7)

4. Use the Stiffness Method (considering flexural deformations only) to calculate the rotation at joints C and D of the beam $ABCDE$ shown below, if in addition to the applied loads, the support D settles 0.05′ downwards [Given: $P = 0$, $EI = 20 \times 10^3$ k-ft^2].

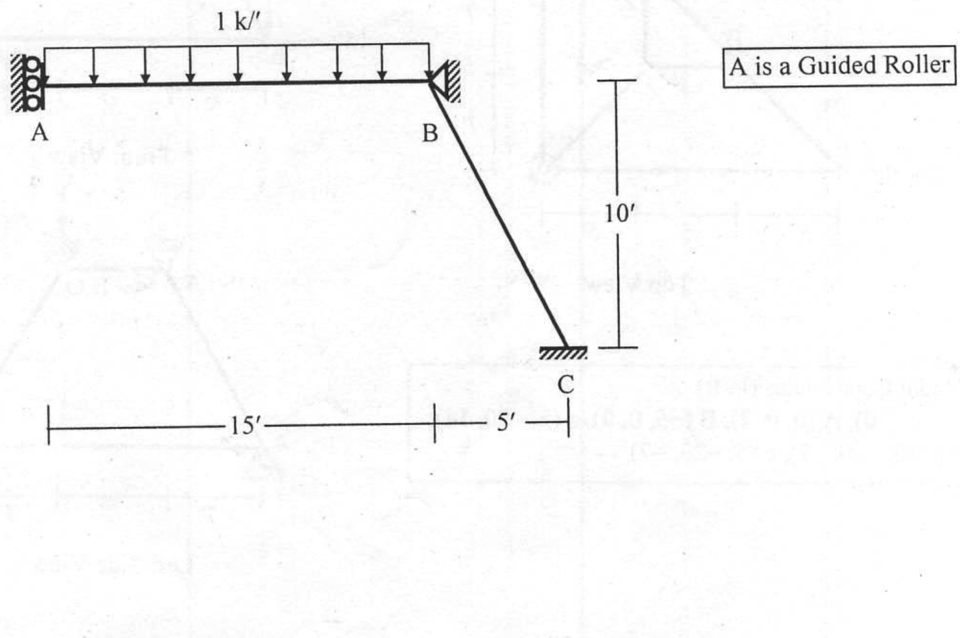


5. Use the Stiffness Method to calculate the forces P needed to cause buckling of the beam ABCDE shown in Question 4, considering flexural deformations only with geometric nonlinearity.

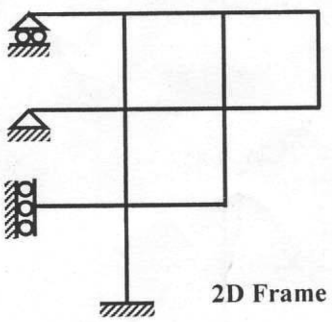
6. Use the Stiffness Method to calculate the rotation at joint C and deflection at B of the frame ABCDE loaded as shown below, considering flexural deformations only. Also calculate the joint moments [Given: $EI_{CA} = EI_{CD} = EI_{CE} = 20{,}000$ k-ft^2, $EI_{CB} = 60{,}000$ k-ft^2]

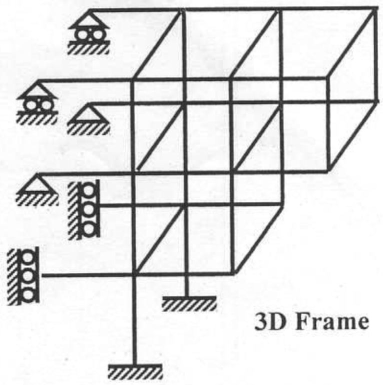


7. Use the Stiffness Method (with flexural deformations only) to calculate the vertical deflection at joint A and rotation at joint B of the frame shown below [Given: EI = constant = 40×10^3 k-ft^2].

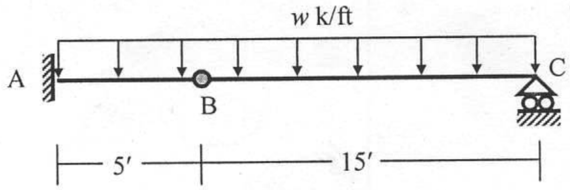


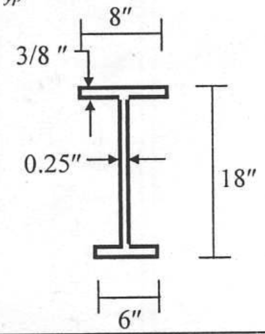
8. Determine the size of the stiffness matrices (considering boundary conditions also) of the frames shown below. Also determine the size of the stiffness matrices if axial deformations are neglected.





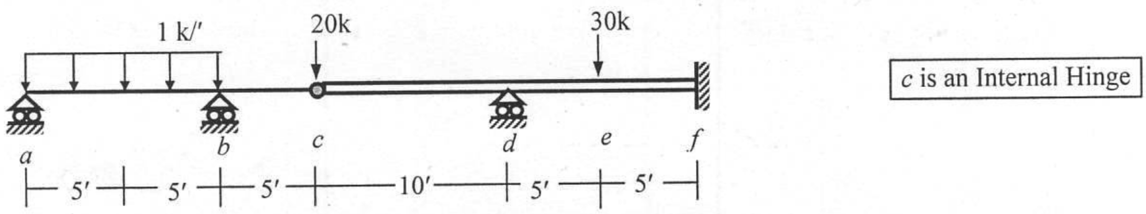
9. Calculate the distributed load w k/ft needed to develop plastic hinge mechanism of the beam ABC loaded as shown below (by using the bending moment diagram) [Given: $\sigma_{yp} = 36$ ksi].





Cross-section of the beam

10. Use the Energy Method to calculate the plastic moment M_p necessary to prevent plastic hinge mechanism from developing in the beam *abcdef* loaded as shown in the following figure [Given: Plastic Moment $M_{p(cdef)} = 2\ M_{p\ (abc)} = M_p$].



11. Use the consistent-mass matrix (considering flexural deformations only) to calculate the natural frequencies of the beam ABCDE described in Question 4, if $M_{AB} = M_{BC} = M_{CD} = 0.20$ k/ft. and $M_{DE} = 0.35$ k/ft.

12. For the truss shown in figure below, calculate the approximate natural frequencies [Given: Modulus of elasticity $E = 30000$ ksi, cross-sectional area $A = 2$ in^2, mass per unit length, $m = 1.5\times10^{-6}$ k-sec^2/in^2 for all the members].