Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

VII SEMESTER B.TECH (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, DEC 2015\ JAN 2016

SUBJECT: FINITE ELEMENT METHOD [AAE 405]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** the questions.
- Missing data may be suitable assumed.

1A. For the beam shown in Figure 1, determine the displacements and the slopes at the node2. **(05)**

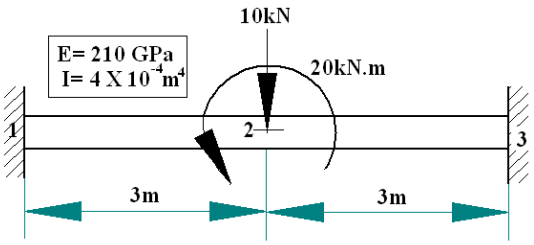


Figure 1

1B. For the beams shown in Figure2, determine the displacements and the slopes at the nodes. **(05)**

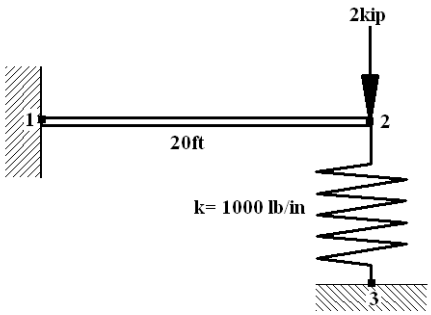


Figure 2

2A. For the beams shown in Figure 3, determine the displacements and the slopes at the nodes. Given: E= $30X10^6$ psi, I=100 in^4. **(05)**

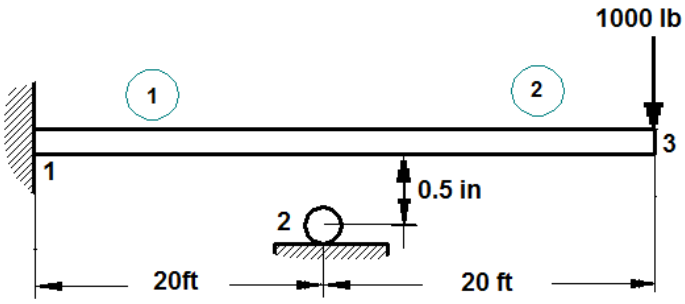


Figure 3

2B. Use the principle of minimum potential energy to solve the spring problems shown in Figure 4. Determine the nodal displacement. **(05)**

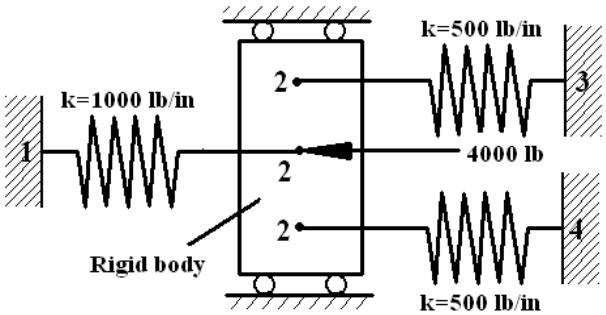


Figure 4

3A. For the truss shown in Figure 5, use symmetry to determine the displacements of the nodes and the stresses in each element. All elements have E= $30X10^6$ psi. Elements 1, 2, 4, and 5 have A =10 in^2 and element 3 has A =20 in^2. **(07)**

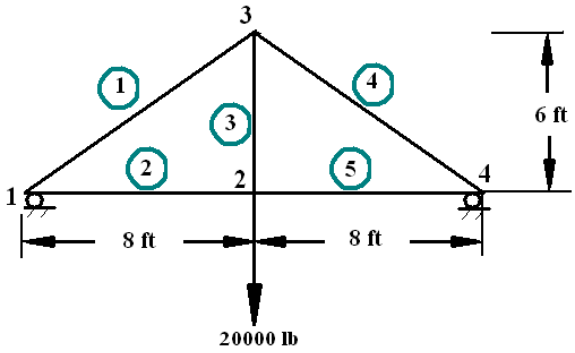


Figure 5

3B. Briefly explain Co-ordinate systems used in FEM. **(03)**

4. For the beams shown in Figure 6, determine the nodal displacements and slopes, the forces in each element, and the reactions. **(10)**

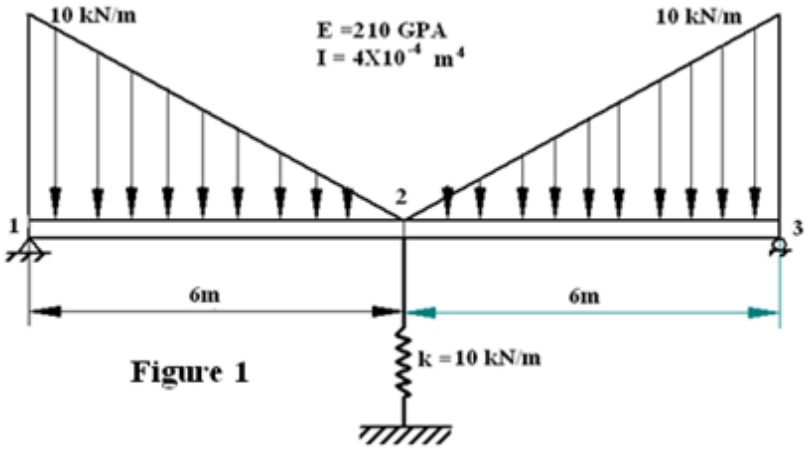
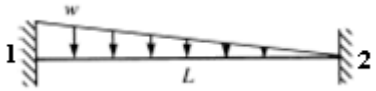


Figure 6

	f_{1y}	m_1	f_{2y}	m_2
	$\frac{-7wL}{20}$	$\frac{-wL^2}{20}$	$\frac{-3wL}{20}$	$\frac{wL^2}{30}$

5. For the plane trusses shown in Figure 7, determine the horizontal and vertical displacements of node 1 and the stresses in each element. All elements have E =210 GPa and A= 4X 10^{-4} m^2. **(10)**

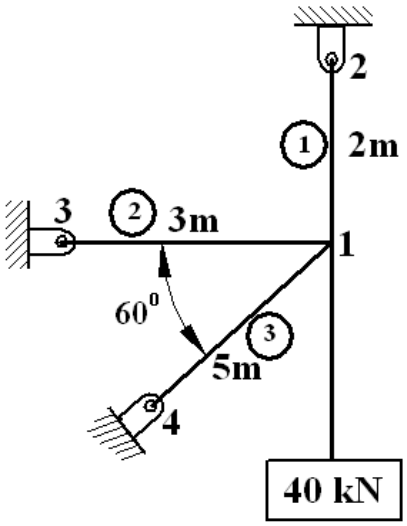


Figure 7

6. For the plane strain elements shown in Figure 8 , the nodal displacements are given as **(10)**

u1 = 0.001 in: v1 = 0.005 in: u2 = 0.001 in:
v2 = 0.0025 in: u3 = 0.0 in: v3 = 0.0 in:

Determine the stiffness and element stresses $\sigma_x, \sigma_y, \tau_{xy}, \sigma_1, \text{and } \sigma_2$ and the principal angle θ_p. Let E = 30X10^6 psi and $\vartheta = 0.25$, and use unit thickness for plane strain. All coordinates are in inches.

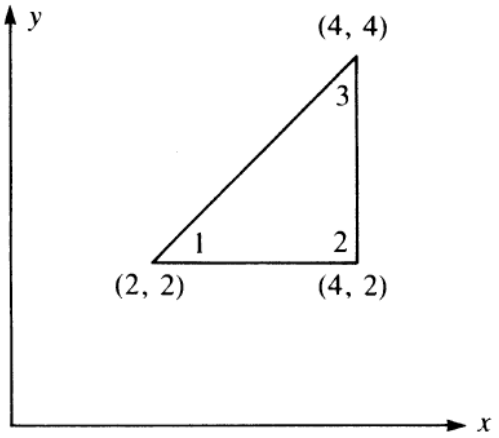


Figure 8