Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VI SEMESTER B.TECH. (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, JUNE 2018

SUBJECT: FINITE ELEMENT METHOD [AAE 3202]

REVISED CREDIT SYSTEM
(18/06/2018)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A. For the truss assemblages shown in Figure 1, determine the nodal displacements, Use the direct stiffness method **(05)**

Given Data: E_{st} = 200GPa, E_{al} = 70GPa, A_{st} = 4x10^{-4} m^2, A_{al} = 2x10^{-4} m^2.

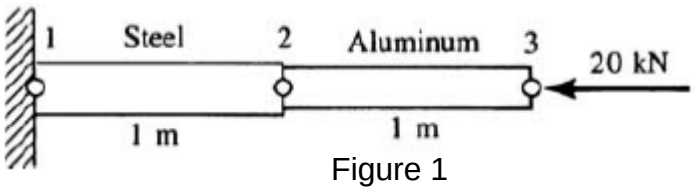


Figure 1

1B. For the beam shown in Figure 2, determine the displacements and the slopes at the nodes. **(05)**

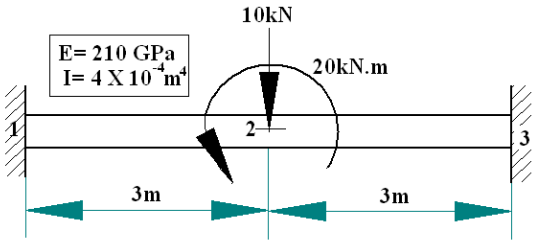


Figure 2

2A. For the beams shown in Figure 3, determine the displacements and the slopes at the nodes. E = 29 x 10^6 psi and I= 200 in^4 **(05)**

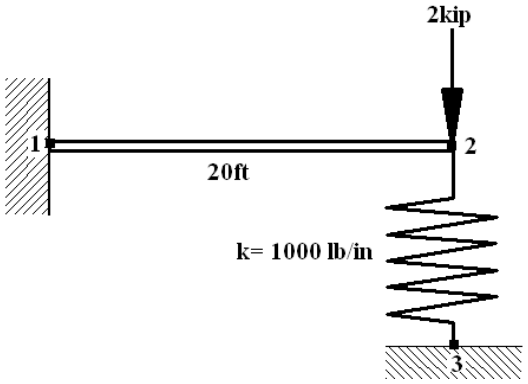


Figure 3

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

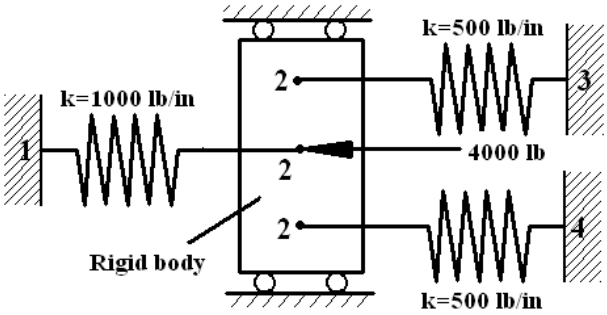


Figure 4

3. For the plane stress supported by the spring at node 1 shown in figure 5, determine the nodal displacements and stresses in each elements. **(10)**
Let E= 210 GPa and A= $5X10^{-4}$ m^2 for both the truss elements.

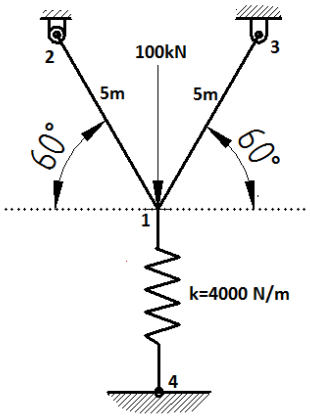


Figure 5

4. For the beam shown in Figure 6, subjected to the concentrated load P and the linearly varying line load w, determine the free-end deflection and rotation and the reactions. Use the equivalent load replacement method. Let EI be constant throughout the beam. **(10)**

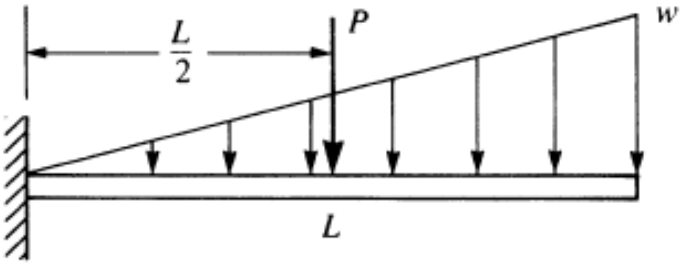
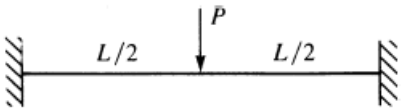


Figure 6

Force equivalent diagram	f1y	m1	f2y	m2
	$\frac{-P}{2}$	$\frac{-PL}{8}$	$\frac{-P}{2}$	$\frac{PL}{8}$
	$\frac{-7wL}{20}$	$\frac{-wL^2}{20}$	$\frac{-3wL}{30}$	$\frac{wL^2}{30}$

5. For the plane strain elements shown in Figure 7 , the nodal displacements are given as **(10)**

$u_1 = 0.001$ in: $v_1 = 0.005$ in: $u_2 = 0.001$ in:

$v_2 = 0.0025$ in: $u_3 = 0.0$ in: $v_3 = 0.0$ in:

Determine the 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.

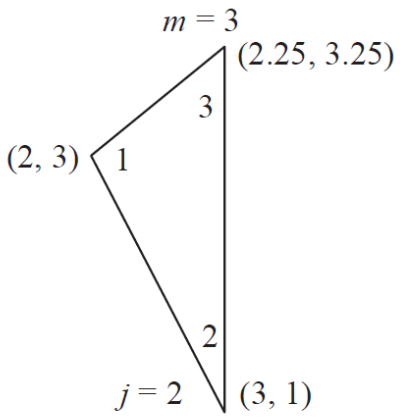


Figure 7