Reg.No.					



MANIPAL INSTITUTE OF TECHNOLOGY Manipal University, Manipal – 576 104



# VI SEMESTER B.TECH (AUTOMOBILE ENGINEERING)

## **END SEMESTER EXAMINATIONS, JULY 2016**

#### SUBJECT: PROGRAM ELECTIVE II- FINITE ELEMENT METHOD (AAE-372) REVISED CREDIT SYSTEM

#### Time: 3 Hours.

MAX.MARKS: 50

### Instructions to Candidates:

- ✤ Answer ANY FIVE FULL questions.
- Missing data, if any, may be suitably assumed and stated clearly.
- 1A) For the beam shown in Figure, determine the displacements and the (05) slopes at the nodes.



1B) For the spring assemblage shown in Figure, determine the displacement (05) at node 2 and the forces in each spring element. Also determine the force F3. Given: Node 3 displaces an amount  $\delta$ = 1 in. in the positive x direction because of the force F3 and k<sub>1</sub> = k<sub>2</sub> = 500 lb/in.

2A) Use the principle of minimum potential energy to solve the spring (05) problems shown in Figure.



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2B) For the assemblages shown in Figures, determine the nodal (05) displacements, the forces in each element. Use the direct stiffness method for these problems. E= 70 GPa, A= 2X10<sup>-4</sup> m<sup>2</sup>, k=2000kN/m.



3A) For the truss shown in Figure, use symmetry to determine the (07) displacements of the nodes and the stresses in each element. All elements have  $E = 30X0^6$  psi. Elements 1, 2, 4, and 5 have A =10 in<sup>2</sup> and element 3 has A =20 in<sup>2</sup>.



3B) List the steps used in FEM.

(03)

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



N N N N N N N N N N N N N N N N N N N	f <sub>1y</sub>	m₁	f <sub>2y</sub>	m <sub>2</sub>
	-7wL	$-wL^2$	-3wL	$wL^2$
	20	20	20	30

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



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

 $u_1 = 0.001$  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 stiffness and element stresses  $\sigma_x, \sigma_y, \tau_{xy}, \sigma_1$ , and  $\sigma_2$ and the principal angle  $\theta_p$ . Let E = 30X10<sup>6</sup> psi and  $\vartheta$  = 0.25, and use unit thickness for plane strain. All coordinates are in inches.

