Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

II SEMESTER M.TECH (AUTOMOBILE ENGINEERING)
END SEMESTER EXAMINATIONS, APR/MAY 2019

SUBJECT: FINITE ELEMENT METHODS [AAE 5237]

REVISED CREDIT SYSTEM
(29/04/2019)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates

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

1A. Briefly explain the general steps of Finite Element Analysis **(04)**

1B. For the structure shown in the Figure 1, Find the displacement at each nodal location. Also find the stresses in each member of the structure. Given, E_{steel}=200GPa, E_{al}=70GPa area of cross-section A_{steel}=1000mm^2 A_{al}=700mm^2 **(06)**

2A. For the two bar truss shown in Figure 2, find the displacement at the loading point. Given, *E=210GPa*, area of cross-section $A=6X10^{-4}m^2$ for each element. **(07)**

2B. Derive the stiffness matrix of link element using principal of minimum potential energy. **(03)**

3A. For the 3 Dimensional truss show in Figure 3, Find the displacement of node1. Given, *E=9GPa* for all members. Area of cross-sections, A_1=200mm^2, A_2=500mm^2, A_3=60mm^2. Node 1 is supported by a roller which prevents y-direction displacement(coordinate locations are in mm) **(08)**

3B. Briefly explain plane stress and plane strain assumption. **(02)**

4A. For the triangular element shown in Figure 4, find the displacement and stress at the node 1 for a load of 1000N, when node 2 and node 3 are fixed. Assume plane stress conditions. *E=200GPa,Thickess=1mm,poison's ratio 0.3* **(10)**

5A. For the structure shown in Figure 5, develop the global stiffness matrix. Given *E=200GPa* and poison's ratio 0f 0.3. Assume plane stress conditions. **(10)**

Note:Followiing formula can be used

$$\alpha_i = x_j y_m - y_j x_m \qquad \alpha_j = y_i x_m - x_i y_m \qquad \alpha_m = x_i y_j - y_i x_j$$

$$\beta_i = y_j - y_m \qquad \beta_j = y_m - y_i \qquad \beta_m = y_i - y_j$$

$$\gamma_i = x_m - x_j \qquad \gamma_j = x_i - x_m \qquad \gamma_m = x_j - x_i$$

$$2A = x_i(y_j - y_m) + x_j(y_m - y_i) + x_m(y_i - y_j)$$

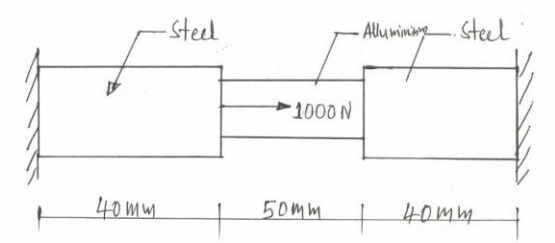

Figure 1

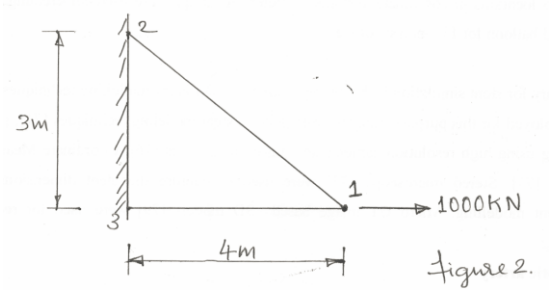

Figure 2

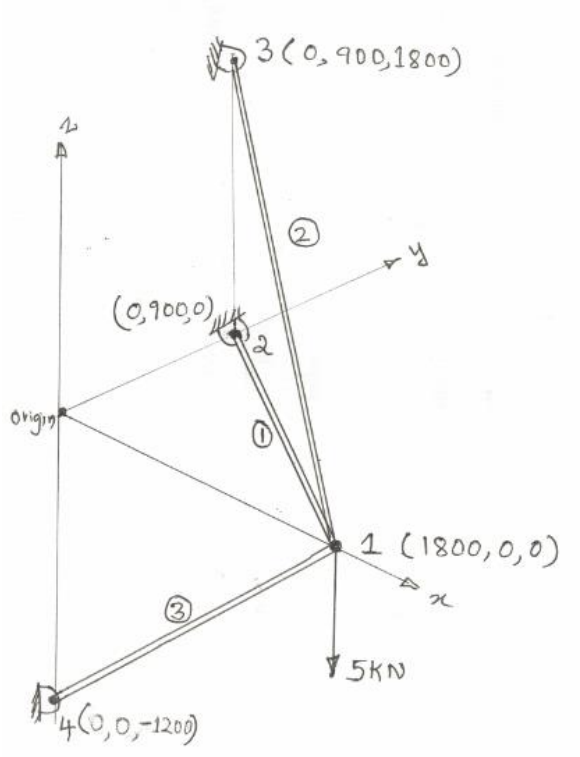

Figure 3

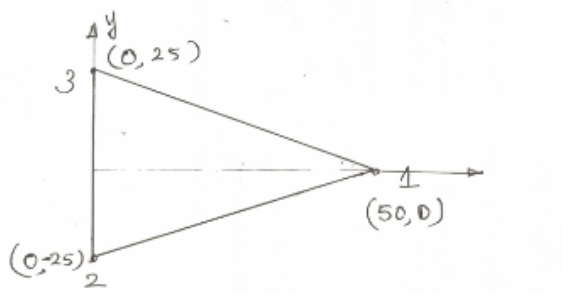

Figure 4

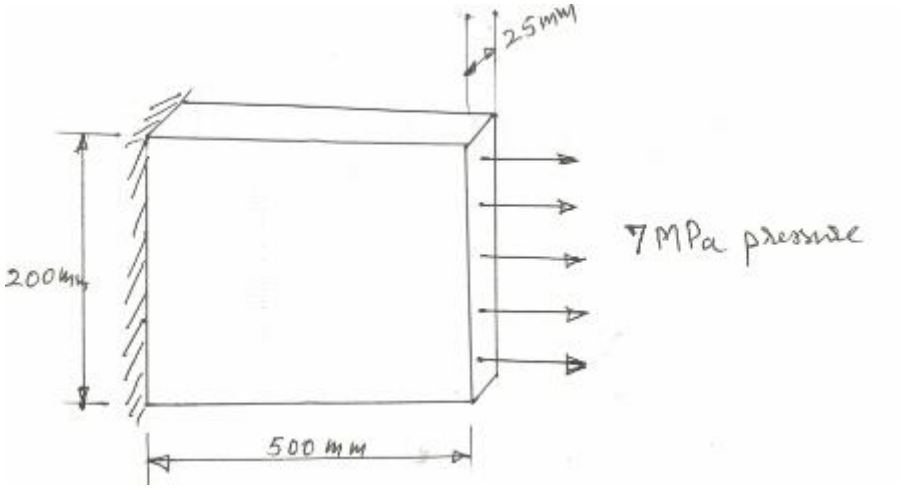

Figure 5