Reg.No. | | | | | | | | | |

# Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

**VI SEMESTER B.TECH (MECHANICAL ENGINEERING)**
**END SEMESTER EXAMINATIONS, JUNE/JULY 2016**

SUBJECT: FINITE ELEMENT METHODS [MME 344]

**REVISED CREDIT SYSTEM**

Time: 3 Hours MAX. MARKS: 50

**Instructions to Candidates**

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

Q.1A A plane truss is shown below in Fig.1, Determine the nodal displacements and the reaction at the pin jointed supports. Given E= 70 GPa. Area of cross section of each member is 300 mm$^2$. Exploit the symmetry. (07)

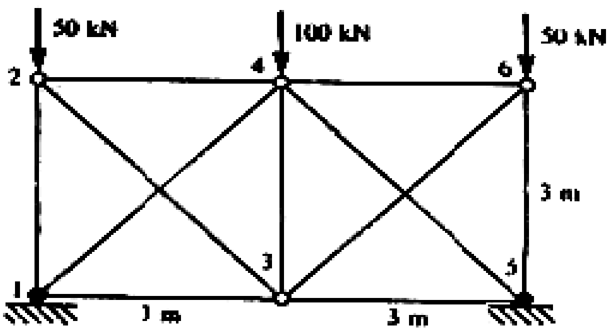



**Fig. 1**

Q.1B Determine the Shape functions for the four noded Isoparametric rectangular element. Compute the temperature and the heat fluxes at a location (2,1) in the element as shown in Fig.2 (03)

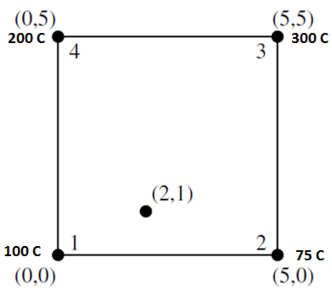



**Fig. 2.**

Q.2A Obtain the deflection by Galerkin Method for a beam which is simply supported and subjected to concentrated moments, $\mathbf{M_0}$ at each end. Use a trial weighting function, (04)

$$W_i(x) = sin\left(\frac{\pi x}{L}\right)$$

Q.2B A steel beam with loading is shown in **Fig.3,** below. Determine the deflection and slope of the beam due to loading. Also determine the support reactions. (06)

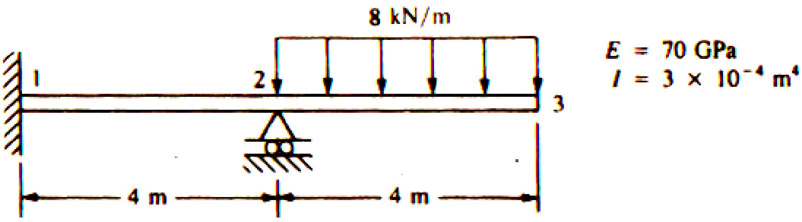
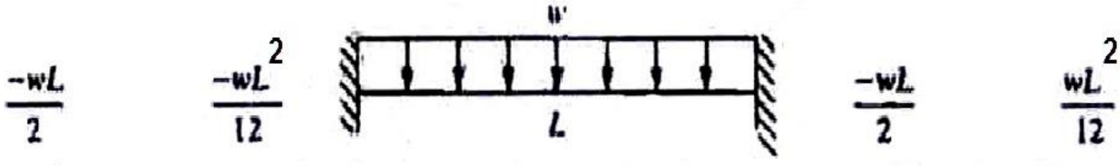



**Fig. 3**




Q.3A Generate Shape functions for a 8-noded rectangular 2-D planar element using Lagrangian interpolation function. (04)

Q.3B Apply Iso-parametric approach to develop the element stiffness matrix [K] for a three noded uniaxial bar (truss) element whose area is constant along its length. (06)

Q.4A For the spring assemblage shown in **Fig 4**, determine the nodal displacements, the forces in each element and the reactions at the constraints, using the direct stiffness method. (06)

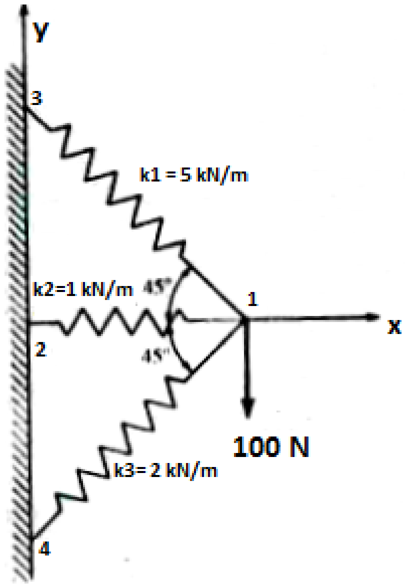



**Fig. 4.**

Q.4B Obtain all the Shape Functions for a Linear Strain Triangular (LST) Element (triangular element with mid side nodes) using Lagrangian Interpolation formula. (04)

Q.5A Derive the Element Stiffness Matrix for a uniaxial 2 noded truss member by applying Galerkin weighted Residual Method. (05)

Q.5B Determine by applying Direct Stiffness method, the nodal displacements at mid node, stresses in each material and support reactions in the bar shown in Fig.5 below due to applied force P = 400 kN at mid node & a uniform temperature rise of $30^0$C. The following data are given. (05)

$A_1 = 2400\ mm^2$, $A_2 = 1200\ mm^2$: $L_1 = 300$ mm, $L_2 = 400$ mm

$E_1 = 0.07 \times 10^6\ N/mm^2$, $E_2 = 0.2 \times 10^6\ N/mm^2$ :

$\alpha_1 = 22 \times 10^{-6}/^0C$, $\alpha_2 = 12 \times 10^{-6}/^0C$

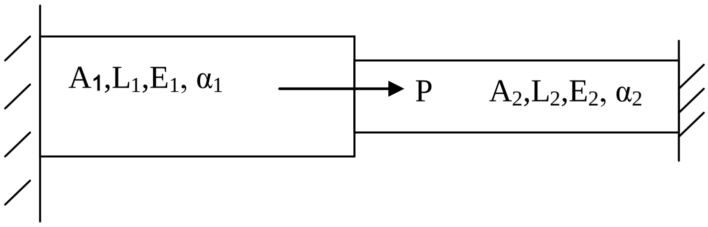



Fig. 5

Q.6A Compute the element stiffness matrix for the **Constant Strain** Triangle (CST) given in **Fig 5** below: (06)

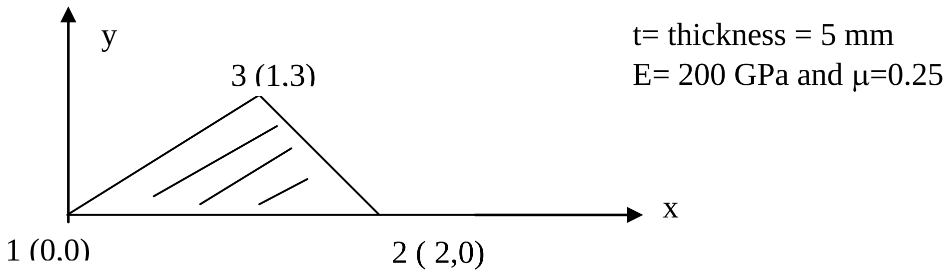



**Fig. 5.**

Q.6B Deduce the Elastic stiffness matrix for 2D complex beam element aligned to the global axis (04)