Reg.No.										

MANIPAL INSTITUTE OF TECHNOLOGY
A Constituent Institute of Manipal University, Manipal

II SEM M. Tech. (CAAD) DEGREE END SEMESTER EXAMINATIONS
APRIL/MAY 2017

SUBJECT: FINITE ELEMENT METHODS (MME 5202)
REVISED CREDIT SYSTEM

Time: 3 Hours. Max. Marks: 50

Instructions to Candidates:
- Answer **ALL** questions.
- Missing data, if any, may be assumed appropriately.
- The use of **CERTIFIED DATA SHEET** is permitted.

1. a) Evaluate the stiffness matrix in the global Cartesian coordinate system for a plane stress triangular element i – j - m defined by the coordinates (4, 4), (10, 6) and (7, 10) respectively, with x-axis of element coordinate system along i-j side of the element. Let E = 200 GPa, μ = 0.3 and t = 10 mm. **(05)**

   b) For the spring assemblage shown in **Fig. Q.1b**, evaluate the unknown displacements using ***potential energy method***. **(05)**

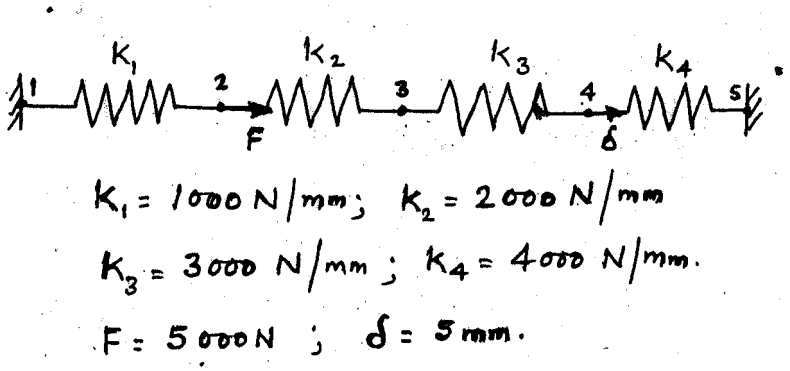

Fig. Q. 1b

2. a) Obtain the stiffness matrix of a beam element in XY plane by Galerkin's Weighted Residual method. **(05)**

b) Evaluate the unknown displacements and element stresses for the plane truss shown in **Fig. Q. 2b** **(05)**

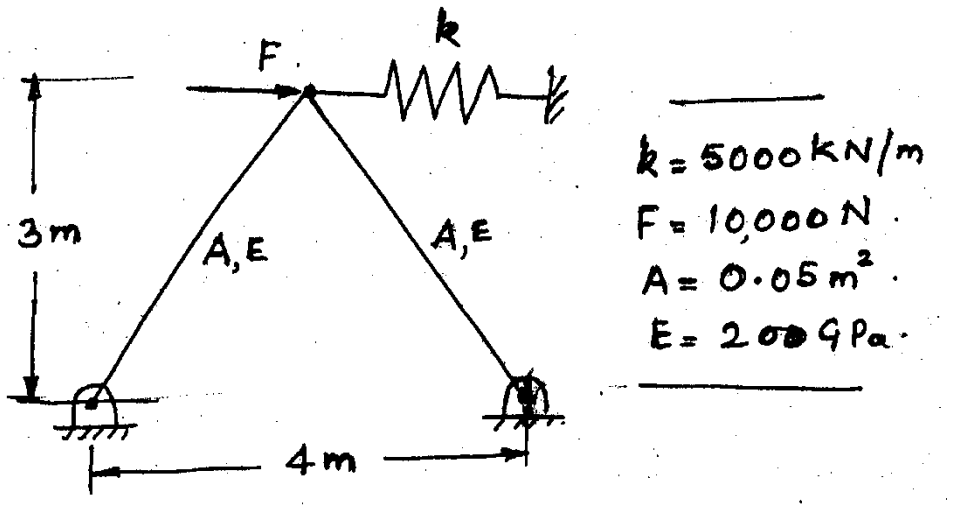

Fig. Q. 2b

3. For the plane frame shown in **Fig. Q. 3**, determine the unknown displacements and rotations of the nodes. Let E = 210 GPa, A = 10^{-2} m^2 and I = $2x10^{-4}$ m^4 for all the elements. **(10)**

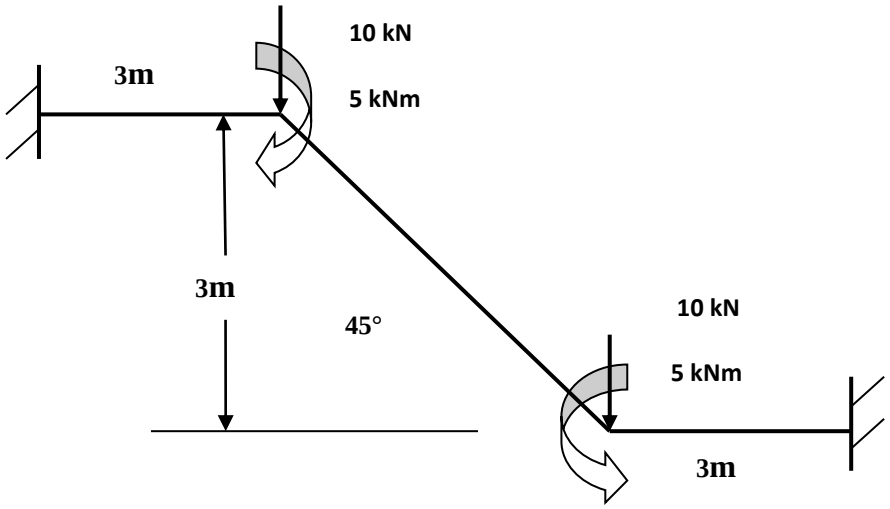

Fig. Q. 3

4. a) Obtain the expression for element stiffness matrix of 8-node hexahedral element by using ***Isoparametric formulation method***. **(06)**

b) For the structure shown in **Fig. Q. 4b** obtain the unknown displacement if, k_1 = 500 kN/m and k_2 = 1000 kN/m. **(04)**

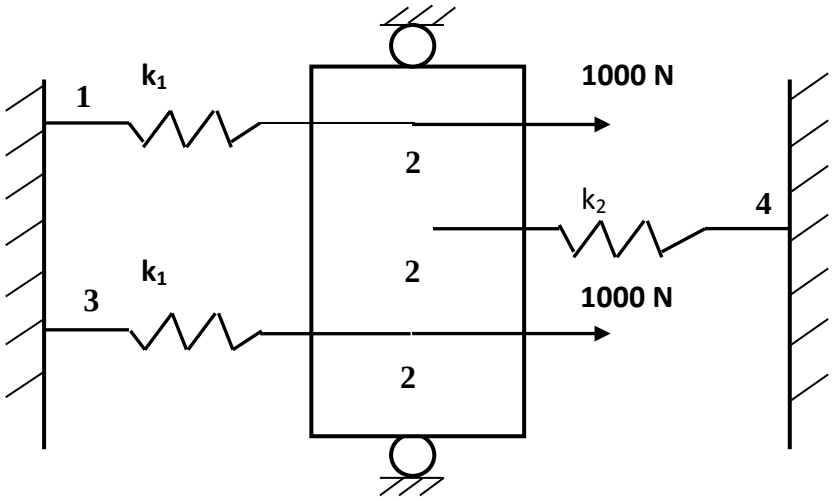

Fig. Q. 4b

5. a) Obtain the stiffness matrix of an arbitrarily oriented truss element in XY plane in the form **(04)**

$$[K] = \frac{AE}{L}\begin{bmatrix} C^2 & CS & -C^2 & -CS \\ CS & S^2 & -CS & -S^2 \\ -C^2 & -CS & C^2 & CS \\ -CS & -S^2 & CS & S^2 \end{bmatrix}$$

where A = cross section area of the truss element
E = Modulus of elasticity
L = length of truss

b) For the beam shown in **Fig. Q. 5b**, evaluate the unknown displacements and rotations. **(06)**

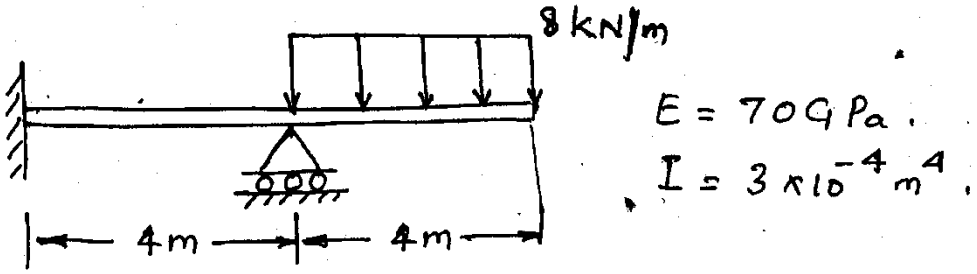

Fig. Q. 5b