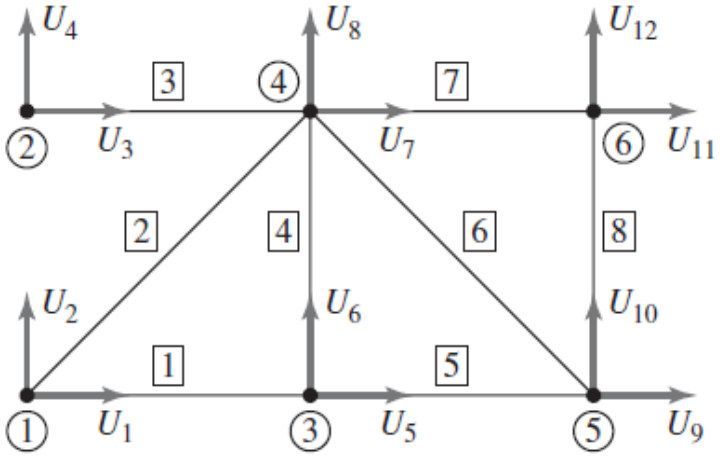
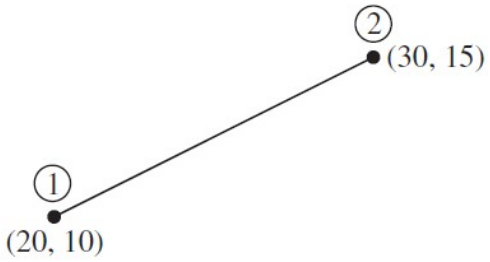
Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2022

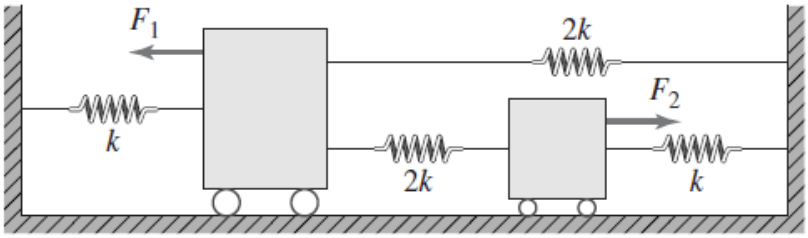
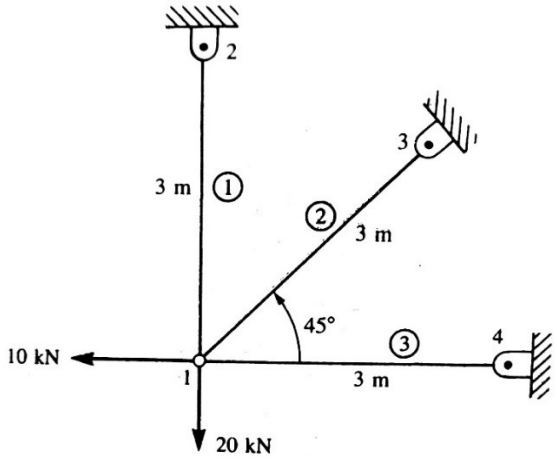
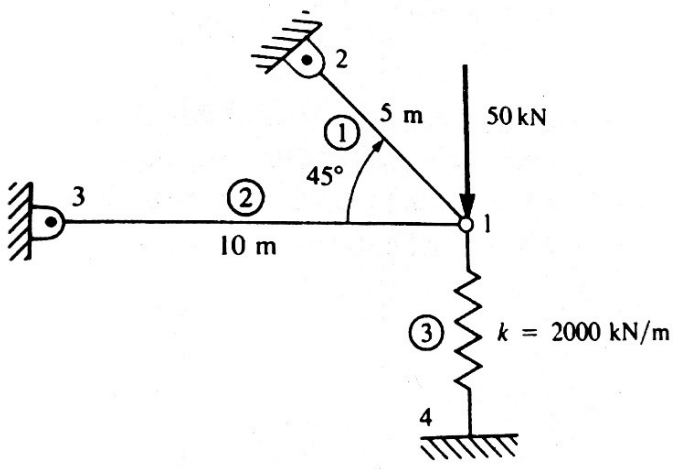
Course: Finite Element Method — **Semester : 8th**
Program: B.Tech ADE — **Time : 03 hrs.**
Course Code: MECH4007P — **Max. Marks: 100**

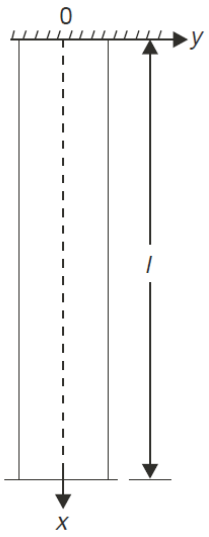
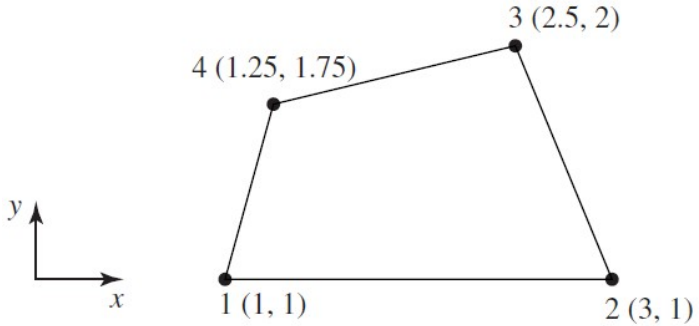
Instructions: Attempt all questions. Assume any data if necessary.

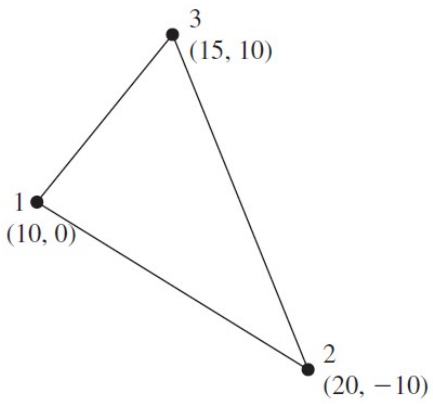
SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Explain the steps of finite element method.	**4**	**CO1**
Q 2	Obtain the connectivity matrix for the truss structure shown below, 	**4**	**CO1**
Q 3	Determine the sample point and its weight in one point formula of numerical integration.	**4**	**CO1**
Q 4	Explain isoperimetric mapping.	**4**	**CO1**
Q 5	Determine the transformation matrix for the truss element shown in Figure. 	**4**	**CO1**

SECTION B

(4Qx10M= 40 Marks)			
Q 6	If k = 50 kN/m, F_1 = 5 kN, and F_2 = 10 kN, compute the displacement of each trolley. 	**10**	**CO3**
Q 7	For the plane truss supported by spring at node 1, determine the individual elemental stiffness matrix of each element. Let E = 210 GPa and A = 5×10^{-4} m^2  **OR** For the plane truss supported by spring at node 1, determine the individual elemental stiffness matrix of each element. Let E = 210 GPa and A = 5×10^{-4} m^2 	**10**	**CO3**

Q 8	Determine the displacement of a fixed bar due to its own weight as shows in Fig, using Rayleigh-Ritz method. Take a 2nd order polynomial as approximate displacement function. Take $E = 1$ GPa, $A = 1$ m^2, $\rho = 2$ kg/m^3 and $l = 2$. 	**10**	**CO3**
Q 9	Determine the sampling points and its weights in two-point formula of numerical integration and evaluate the integral, $$\int_{-1}^{1}\int_{-1}^{1}(r^3-1)(s^2+s)\,dr\,ds$$	**10**	**CO1**
	SECTION-C (2Qx20M=40 Marks)		
Q 10	Determine the inverse of the Jacobian matrix for the rectangular plate element shown in Figure. The coordinates are in the units of meters. 	**20**	**CO2**
Q 11	Determine the **[B]** matrix in natural coordinates for the plate element shown in Figure. The coordinates are in units of meters.	**20**	**CO2**



OR

Determine the **[B]** matrix in natural coordinates for the plate element shown in Figure. The coordinates are in units of meters.