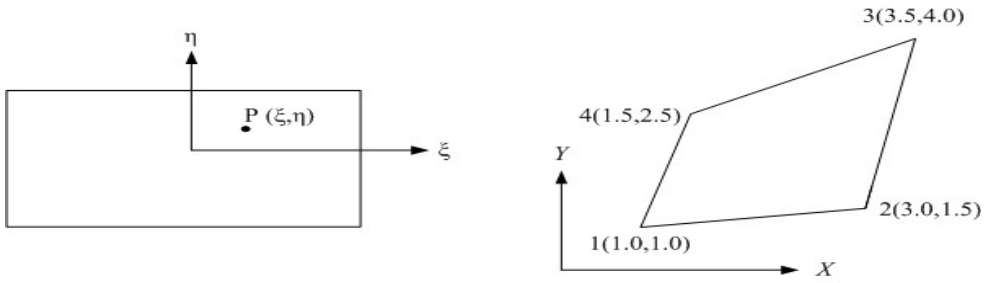
Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

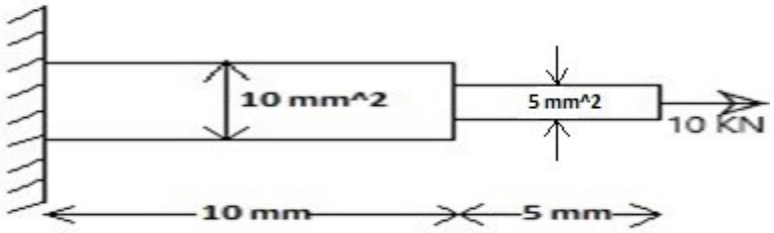
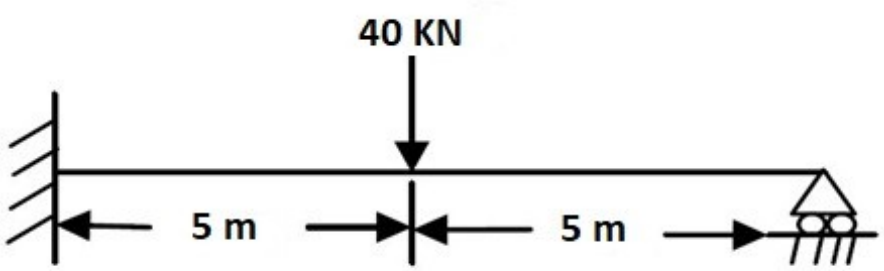
Course: Finite Element Method for Fluid Dynamics
Course Code: ASEG 7022 **Semester: I**
Programme: M.Tech CFD
Time: 03 hrs. **Max. Marks: 100**
Instructions: All questions are compulsory.

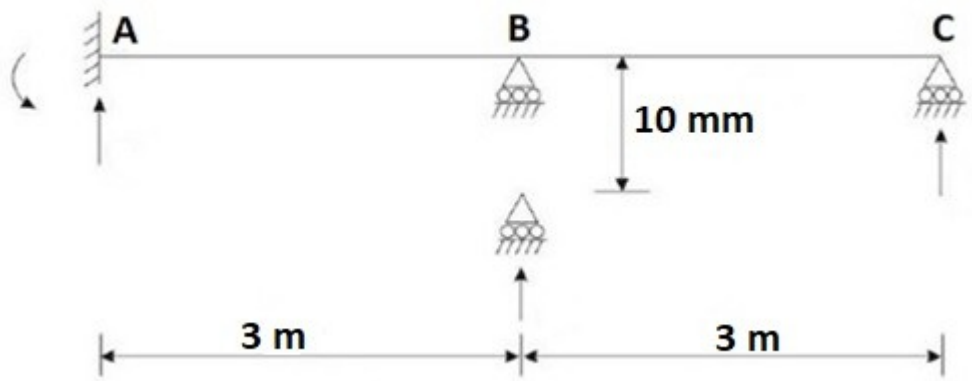
SECTION A

S. No.		Marks	CO
Q 1	Explain the steps involved in solving a structural problem numerically.	**4**	**CO1**
Q 2	Explain following terms: i. Nodes ii. Elements iii. Domain iv. Shape Function	**4**	**CO1**
Q 3	Explain the process of obtaining global stiffness matrix from the superimposition of element stiffness matrices with suitable example.	**4**	**CO1**
Q 4	Determine the Cartesian coordinate of the point P (ξ= 0.8, η= 0.9) as shown in figure below: 	**4**	**CO2**
Q 5	Emphasis on various tools available in FEM software for post processing.	**4**	**CO5**

SECTION B

Q 6	A two element two nodded bar is shown in figure given below. Determine the nodal displacement and nodal reaction forces. The bar is made up of steel.	**10**	**CO1**

	 OR Derive weighted residual and principle of virtual work formulations.		
Q 7	Illustrate finite element formulation for heat conduction analysis.	**10**	**CO3**
Q 8	Derive the strain displacement relationship matrix for plane stress rectangular elements.	**10**	**CO3**
Q 9	Illustrate the following: i. Pre-processing ii. Post-processing	**10**	**CO5**
	SECTION-C		
Q 10	Calculate the nodal displacement and reactions at supports for the beam shown in figure. Take E = 200 GPa and I= 24 x 10^{-6} m^4.  OR Derive the strain displacement relationship matrix for 2D isoparametric element.	**20**	**CO2**
Q 11	Using direct stiffness method, calculate support reactions in the continuous beam ABC, having constant flexural rigidity EI throughout due to vertical settlement of support B , by 5mm as shown in the figure. Assume E = 200 GPa and I = 4 X 10^{-4} m^4	**20**	**CO4**

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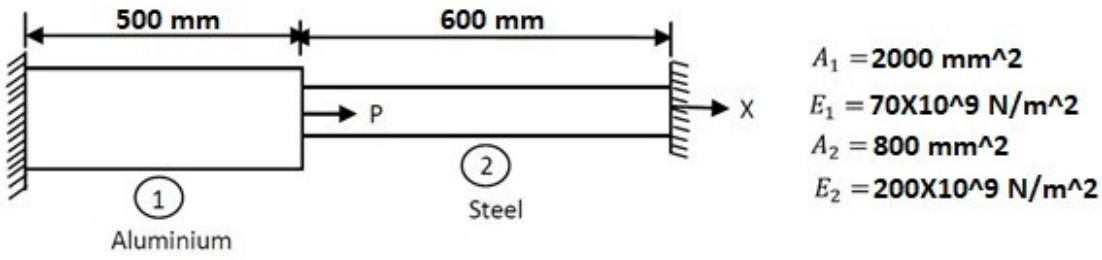
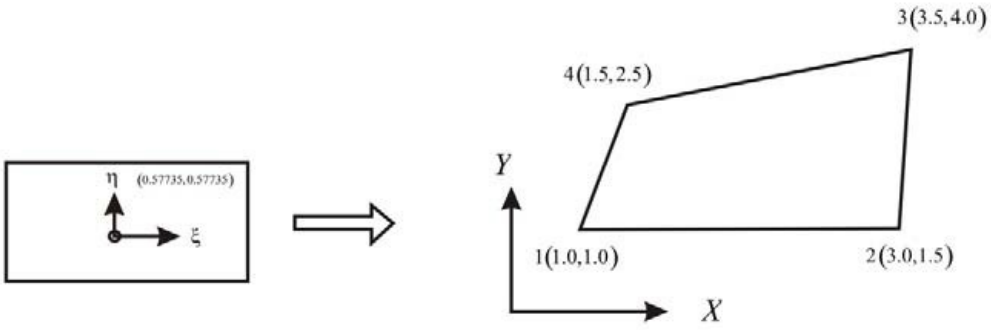
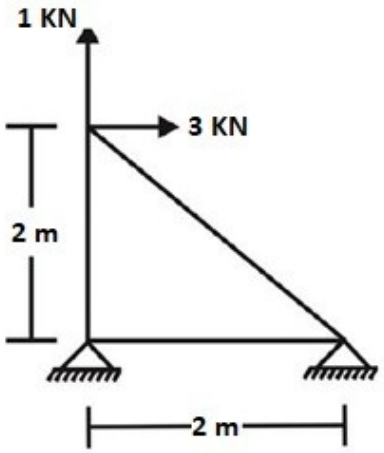
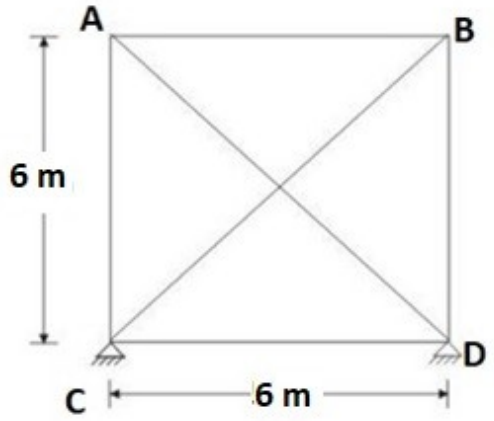
SECTION A

S. No.		Marks	CO
Q 1	Write down the advantages, disadvantages and applications of finite element method.	**4**	**CO1**
Q 2	Define boundary conditions and its type.	**4**	**CO1**
Q 3	Define isoparametric, subparametric and superparametric elements.	**4**	**CO2**
Q 4	Define global and local co-ordinate systems. Explain the necessity of local co-ordinate system.	**4**	**CO2**
Q 5	Emphasis on various tools available in FEM software for post processing.	**4**	**CO5**
	SECTION B		
Q 6	Determine the nodal displacements and the reaction forces for the bar shown in figure. An axial load P = 200 KN is applied as shown.	**10**	**CO1**

	 OR Derive weighted residual and principle of virtual work formulations.		
Q 7	Derive the strain displacement relationship matrix for Constant Strain Triangle.	**10**	**CO3**
Q 8	Illustrate finite element formulation of Plane bending analysis problem.	**10**	**CO3**
Q 9	Emphasis on the significance of adaptive grid.	**10**	**CO5**
	SECTION C		
Q 10	Calculate the Jacobian matrix and the strain displacement matrix for four node two dimensional quadrilateral elements corresponding to the point (ξ=0.57735, η= 0.57735) as shown in fig, below  OR Analyze the truss shown below by finite element method. Assume the cross sectional area of the inclined member as 1.5 times the area (A) of the horizontal and vertical members. Assume modulus of elasticity is constant for all the members and is E.	**20**	**CO2**

			
Q 11	Using direct stiffness method, evaluate the member forces of truss shown in Figure below. The temperature of the member BC is raised by 30 ^{0}C and member BD is raised by 40 ^{0}C. Assume AE=300KN for all members and $\alpha = \frac{1}{75000}$ per ^{0}C. 	**20**	**CO4**