JEPPIAAR ENGINEERING COLLEGE

Jeppiaar Nagar, Rajiv Gandhi Salai – 600 119

DEPARTMENT OFMECHANICAL ENGINEERING

QUESTION BANK

VI SEMESTER

ME6603 – FINITE ELEMENT ANALYSIS

Regulation – 2013

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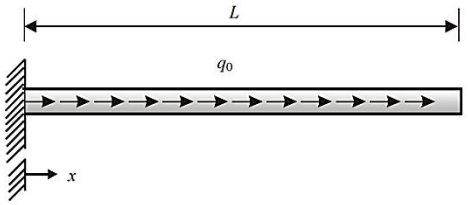
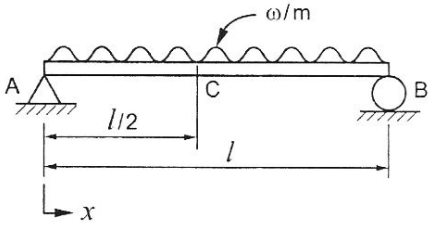
SUBJECT : ME6603 – FINITE ELEMENT ANALYSIS

YEAR /SEM: III /VI

UNIT I INTRODUCTION				
Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – RitzTechnique – Basic concepts of the Finite Element Method.				
PART – A				
CO Mapping : CO613.1				
Q.No	**Questions**	**BT Level**	**Competence**	**PO**
1	State the methods of Engineering analysis.	**BTL-1**	**Remembering**	**PO2,PO3**
2	What is meant by finite element?	**BTL-1**	**Remembering**	**PO1,PO4,PO12**
3	What is meant by finite element analysis?	**BTL-1**	**Remembering**	**PO2,PO4**
4	Give examples for the finite element.	**BTL-5**	**Evaluating**	**PO2,PO3**
5	What is meant by node or joint?	**BTL-1**	**Remembering**	**PO1,PO2**
6	What is the basis of finite element method?	**BTL-1**	**Remembering**	**PO1,PO2**
7	What are the types of boundary conditions?	**BTL-1**	**Remembering**	**PO1,PO3**
8	State the three phases of finite element method	**BTL-1**	**Remembering**	**PO1,PO2**
9	What is structural and non-structural problems?	**BTL-1**	**Remembering**	**PO1,PO2,PO3**
10	What are the methods are generally associated with the finite element analysis?	**BTL-1**	**Remembering**	**PO1,PO3**
11	Explain force method and stiffness method?	**BTL-2**	**Understanding**	**PO1,PO2,PO12**

12	Why polynomial type of interpolation functions are mostly used in FEM?	**BTL-1**	**Remembering**	**PO2,PO3**
13	Name the variational methods.	**BTL-1**	**Remembering**	**PO1,PO3**
14	Name the weighted residual methods.	**BTL-1**	**Remembering**	**PO1,PO2**
15	What is meant by post processing?	**BTL-1**	**Remembering**	**PO1,PO2,PO12**
16	What is Rayleigh-Ritz method?	**BTL-1**	**Remembering**	**PO1,PO2**
17	What is meant by discretization and assemblage?	**BTL-1**	**Remembering**	**PO1,PO3,PO4**
18	What is meant by degrees of freedom?	**BTL-1**	**Remembering**	**PO1,PO2**
19	What is "Aspect ratio"?	**BTL-1**	**Remembering**	**PO1,PO12**
20	What is truss element?	**BTL-1**	**Remembering**	**PO1,PO2**
21	List the two advantages of post-processing.	**BTL-1**	**Remembering**	**PO1,PO2,PO12**
22	If a displacement field in x direction is given by u = 2 x2 + 4 y2 + 6 xy. Determine the strain in x direction.	**BTL-5**	**Evaluating**	**PO2,PO12**
23	What are and `p' versions of finite element method?	**BTL-1**	**Remembering**	**PO1**
24	During discretization, mention the places where it is necessary to place a node?	**BTL-1**	**Remembering**	**PO1,PO12**
25	What is the difference between static and dynamic analysis?	**BTL-1**	**Remembering**	**PO1,PO12**
26	Name any four FEA softwares.	**BTL-2**	**Understanding**	**PO1,PO8,PO11**
27	Differentiate between global and local axes.	**BTL-2**	**Understanding**	**PO2**
28	Distinguish between potential energy function and potential energy functional.	**BTL-4**	**Analyzing**	**PO2**
29	What do you mean by constitutive law?	**BTL-1**	**Remembering**	**PO1**
30	Mention the basic steps of Rayleigh-Ritz method.	**BTL-1**	**Remembering**	**PO1,PO3**
31	Distinguish between Error in solution and Residual.	**BTL-4**	**Analyzing**	**PO2,PO4**
32	What is meant by weak formulation?	**BTL-1**	**Remembering**	**PO1,PO2**
33	What are the advantages of weak formulation?	**BTL-1**	**Remembering**	**PO1,PO2**
34	Distinguish between 1D bar element and 1D beam element.	**BTL-4**	**Analyzing**	**PO2,PO12**
35	What is Galerkin's method of approximation?	**BTL-1**	**Remembering**	**PO1,PO2**
	PART – B & C			
1	List and briefly describe the steps of the Finite	**BTL-1**	**Remembering**	**PO1,PO2,PO4**

	Element Method.			
2	A uniform rod subjected to a uniform axial load is illustrated in fig. The deformation of the bar is governed by the differential equation given below. Determine the displacement using weighted residual method.  $$AE\frac{d^2u}{dx^2} + q_0 = 0$$ with the boundary conditions u(0)=0, $\frac{du}{dx}\Big\|_{x=L} = 0$	**BTL-5**	**Evaluating**	**PO1,PO2,PO3 ,PO11**
3	The following differential equation is available for a physical phenomenon. $$\frac{d^2y}{dx^2} + 50 = 0; 0 \le x \le 10$$ The Trial function is $y = a_1x(10 - x)$ The boundary conditions are: y(0)=0 y(10)=0 Find the value of the parameter a1 by the following methods (i) Least square method (ii) Galerkin's method	**BTL-5**	**Evaluating**	**PO1,PO2.PO3 ,PO12**
4	Find the deflection at the centre of the simply supported beam of span length 'l' subjected to uniformly distributed load throughout its length as shown in figure using (i) point collocation method (ii) sub-domain method.  	**BTL-1**	**Remembering**	**PO1,PO2,PO4 ,PO11**
5	A simply supported beam is subjected to uniformly distributed load over entire span and it	**BTL-5**	**Evaluating**	**PO1,PO2,PO4 ,PO12**

	is subjected to a point load at the centre of the span. Calculate the deflection using Rayleigh-Ritz method and compare with exact solutions.			
6	Derive the element level equation for one dimensional bar element based on the stationary of a function.	**BTL-6**	**Creating**	**PO1,PO3,PO11,PO12**

UNIT II ONE-DIMENSIONAL PROBLEMS

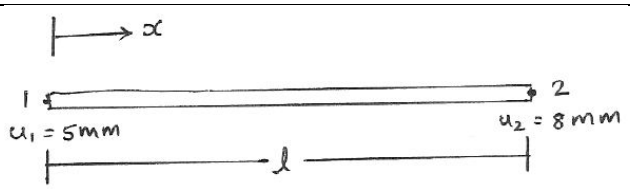
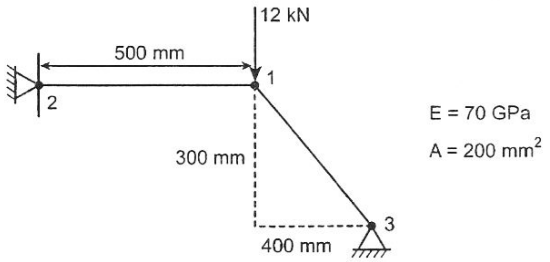
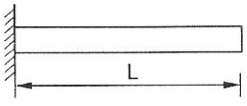
One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices - Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation – Transverse deflections and Natural frequencies of beams.

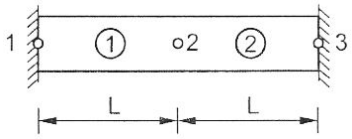
PART – A

CO Mapping : CO613.2

Q.No	Questions	BT Level	Competence	PO
1	What are the types of loading acting on the structure?	BTL-1	Remembering	PO1,PO3
2	Define body force (f).	BTL-1	Remembering	PO1,PO2
3	Define Traction force (T).	BTL-1	Remembering	PO1,PO2
4	What is Point Load (P).	BTL-1	Remembering	PO1,PO2,PO3
5	What are the basic steps involved in the finite element modelling.	BTL-1	Remembering	PO1,PO2
6	What is discretization?	BTL-1	Remembering	PO1
7	What are the classification of co-ordinates?	BTL-1	Remembering	PO1
8	What is Global co-ordinates?	BTL-1	Remembering	PO1
9	What is natural co-ordinates?	BTL-1	Remembering	PO1,PO2
10	Define shape function.	BTL-1	Remembering	PO1,PO2
11	What are the characteristics of shape function?	BTL-1	Remembering	PO1,PO2
12	Why polynomials are generally used as shape function?	BTL-1	Remembering	PO1
13	How do you calculate the size of the global stiffness matrix?	BTL-1	Remembering	PO1
14	Give the general expression for element stiffness matrix.	BTL-2	Understanding	PO1,PO2
15	Write down the expression of stiffness matrix for one dimensional bar element.	BTL-1	Remembering	PO1
16	State the properties of a stiffness matrix.	BTL-1	Remembering	PO1,PO2,PO6
17	Write down the general finite element equation.	BTL-3	Applying	PO1,PO2,PO3
18	Write down the finite element equation for one dimensional two noded bar element.	BTL-3	Applying	PO1,PO2
19	What is truss?	BTL-1	Remembering	PO1,PO11,PO12

20	State the assumptions are made while finding the forces in a truss.	**BTL-1**	**Remembering**	**PO1,PO2**
21	Write down the expression of stiffness matrix for a truss element.	**BTL-3**	**Applying**	**PO1,PO2,PO4**
22	Define total potential energy.	**BTL-1**	**Remembering**	**PO1,PO2**
23	State the principle of minimum potential energy.	**BTL-1**	**Remembering**	**PO1,PO2**
24	What is the stationary property of total potential energy.	**BTL-1**	**Remembering**	**PO1,PO3**
25	State the principles of virtual work.	**BTL-1**	**Remembering**	**PO1,PO11,PO12**
26	Distinguish between essential boundary conditions and natural boundary conditions.	**BTL-4**	**Analyzing**	**PO1**
27	What are the differences between boundary value problem and initial value problem.	**BTL-1**	**Remembering**	**PO2,PO11**
28	Define heat transfer.	**BTL-1**	**Remembering**	**PO1,PO11**
29	Write down the stiffness matrix equation for one dimensional heat conduction element.	**BTL-3**	**Applying**	**PO1**
30	Define frequency of vibration.	**BTL-1**	**Remembering**	**PO1,PO2**
31	Define Damping ratio.	**BTL-1**	**Remembering**	**PO1,PO2**
32	What is meant by longitudinal vibrations?	**BTL-1**	**Remembering**	**PO1,PO3**
33	What is meant by transverse vibrations?	**BTL-1**	**Remembering**	**PO1,PO3**
34	Define magnification factor.	**BTL-1**	**Remembering**	**PO1,PO2**
35	Write down the expression of longitudinal vibration of bar element.	**BTL-3**	**Applying**	**PO2,PO3,PO11**
36	Write down the expression of governing equation for free axial vibration of rod.	**BTL-3**	**Applying**	**PO1,PO3,PO11**
37	What are the types of Eigen value problems?	**BTL-1**	**Remembering**	**PO1,PO3**
38	State the principle of superposition.	**BTL-1**	**Remembering**	**PO1,PO11,PO12**
39	Define resonance.	**BTL-1**	**Remembering**	**PO1,PO2**
40	Define Dynamic Analysis.	**BTL-1**	**Remembering**	**PO1,PO2,PO3**
41	What are methods used for solving transient vibration problems?	**BTL-1**	**Remembering**	**PO1,PO11,PO12**
	PART – B & C			
1	Derive the shape functions for one dimensional linear element using direct method.	**BTL-3**	**Applying**	**PO1,PO2,PO4**
2	A two noded truss element is shown in figure. The nodal displacements are u_1=5mm and u_2=8mm. Calculate the displacement at $x=l/4$, $l/3$ and $l/2$.	**BTL-5**	**Evaluating**	**PO1,PO2,PO4 ,PO12**

				
3	Determine the shape function and element matrices for quadratic bar element.	**BTL-5**	**Evaluating**	**PO1,PO2,PO4 ,PO12**
4	Derive the stiffness matrix for 2D truss element.	**BTL-5**	**Evaluating**	**PO1,PO2,PO3 ,PO11**
5	For the two bar truss shown in the figure, determine the displacements of node 1 and the stress in element 1-3.  E = 70GPa, A = 200mm²	**BTL-4**	**Analyzing**	**PO1,PO2,PO3 ,PO4**
6	Derive an expression for temperature function and shape function for one dimensional heat conduction element.	**BTL-6**	**Creating**	**PO1,PO2,PO1 2,PO6**
7	Derive a finite element equation for one dimensional heat conduction with free end convection.	**BTL-6**	**Creating**	**PO1,PO2,PO3 ,PO12**
8	Consider a uniform cross section bar, as shown in fig of length *L* made up of material whose young's modulus and density is given by *E* and *ρ*. Estimate the natural frequencies of axial vibration of the bar using both consistent and lumped mass matrices. 	**BTL-6**	**Creating**	**PO1,PO2,PO3 ,PO4,PO11,P O12**
9	Determine the natural frequencies and mode shapes of transverse vibration for a beam fixed at both ends. The beam may be modeled by two elements, each of length L and cross-sectional area	**BTL-5**	**Evaluating**	**PO1,PO3,PO1 2**

	A. Consider lumped mass matrix approach.  			

UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS

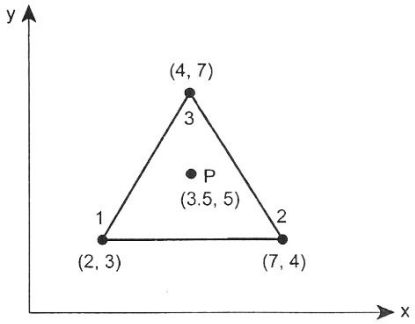
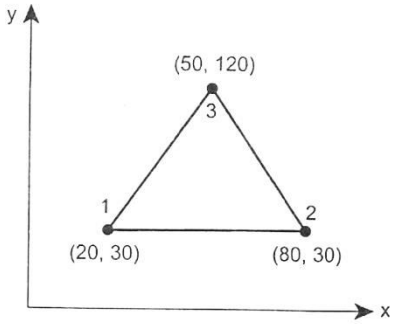
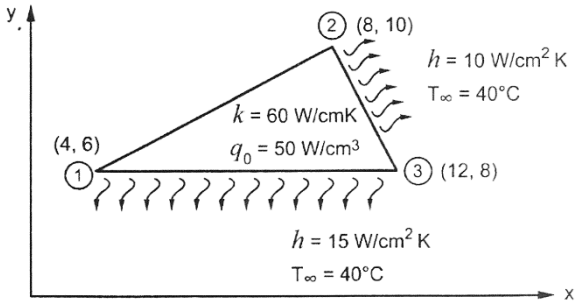
Second Order 2D Equations involving Scalar Variable Functions – Variational formulation – Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.

PART – A

CO Mapping : CO613.3

Q.No	Questions	BT Level	Competence	PO
1	How do you define two dimensional elements?	BTL-1	Remembering	PO1,PO2
2	What is CST element?	BTL-1	Remembering	PO1,PO2
3	What is LST element?	BTL-1	Remembering	PO1,PO2
4	What is QST element?	BTL-1	Remembering	PO1,PO2
5	What is meant by plane stress analysis?	BTL-1	Remembering	PO2,PO3
6	Define plane strain analysis.	BTL-1	Remembering	PO1,PO3
7	Write a displacement function equation for CST element.	BTL-3	Applying	PO1,PO2,PO12
8	Write a strain-displacement matrix for CST element.	BTL-3	Applying	PO1,PO12
9	Write down the stress-strain relationship matrix for plane stress condition.	BTL-3	Applying	PO1,PO2
10	Write down the stress-strain relationship matrix for plane strain condition.	BTL-3	Applying	PO1,PO2
11	Write down the stiffness matrix equation for two dimensional CST element.	BTL-3	Applying	PO1,PO2,PO3
12	Write down the expression for the shape functions for a constant strain triangular element.	BTL-3	Applying	PO1,PO6
13	State the assumptions in the theory of pure torsion.	BTL-1	Remembering	PO1,PO2
14	Write down the finite element equation for torsional bar element.	BTL-1	Remembering	PO1,PO2,PO3
15	Write down the finite element equation for torsional triangular element.	BTL-1	Remembering	PO1,PO2,PO3
16	Define Heat transfer.	BTL-1	Remembering	PO1,PO2,PO12
17	Write down the stiffness matrix equation for one dimensional heat conduction element.	BTL-3	Applying	PO2,PO12

18	Write down the expression of shape function, N and temperature function, T for one dimensional heat conduction element.	**BTL-3**	**Applying**	**PO2,PO3**
19	Write down the finite element equation for one dimensional heat conduction with free end convection.	**BTL-3**	**Applying**	**PO1,PO4**
20	Write down the governing equation for two-dimensional heat conduction.	**BTL-3**	**Applying**	**PO1,PO2,PO4**
21	Write down the shape function for two-dimensional heat transfer.	**BTL-3**	**Applying**	**PO2,PO4**
22	Write down the expression for stiffness matrix in two-dimensional heat conduction and convection.	**BTL-3**	**Applying**	**PO2,PO3,PO4**
23	Define path line.	**BTL-1**	**Remembering**	**PO1,PO2**
24	Define streamline.	**BTL-1**	**Remembering**	**PO1,PO2**
25	What are the four basic sets of elasticity equations?	**BTL-1**	**Remembering**	**PO1,PO2**
26	Give at least one example each for plane stress and plane strain analysis.	**BTL-2**	**Understanding**	**PO2**
27	State whether plane stress or plane strain elements can be used to model the following structures. Justify your answer. a) a wall subjected to wind load b) a wrench subjected to a force in the plane of the wrench.	**BTL-4**	**Evaluating**	**PO1**
28	Differentiate CST and LST elements.	**BTL-2**	**Understanding**	**PO1,PO2,PO3**
29	What are the ways in which a three dimensional problem can be reduced to a two dimensional approach?	**BTL-1**	**Remembering**	**PO1,PO2,PO3**
30	What is meant by two-dimensional scalar variable problem?	**BTL-1**	**Remembering**	**PO1,PO2,PO12**
	PART – B & C			
1	Determine the shape functions for a constant strain triangular (CST) element in terms of natural co-ordinate system.	**BTL-6**	**Creating**	**PO1,PO2,PO12**
2	Determine the shape functions N_1, N_2 and N_3 at the interior point P for the triangular element shown in the figure.	**BTL-6**	**Creating**	**PO1,PO3,PO12**

				
3	Determine the stiffness matrix for the CST Element shown in Figure. The coordinates are given in mm. Assume plane strain condition. E = 210 GPa, v = 0.25 and t = 10 mm 	**BTL-6**	**Creating**	**PO1,PO3,PO12**
4	Determine the expression of shape function for heat transfer in 2D element.	**BTL-6**	**Creating**	**PO1,PO3,PO4**
5	Compute the element matrix and vectors for the element shown in the figure when the edges 2-3 and 3-1 experience heat loss. 	**BTL-4**	**Analyzing**	**PO1,PO2,PO4**
6	Derive the shape functions for 4-noded rectangular element by using natural coordinate system.	**BLT-6**	**Creating**	**PO1,PO2,PO4**

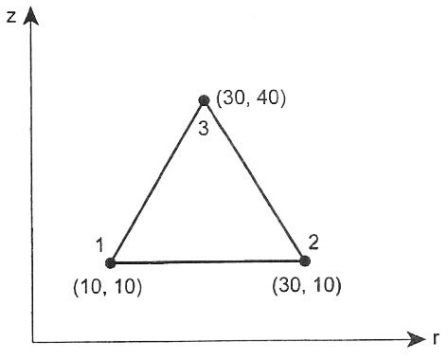
UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS

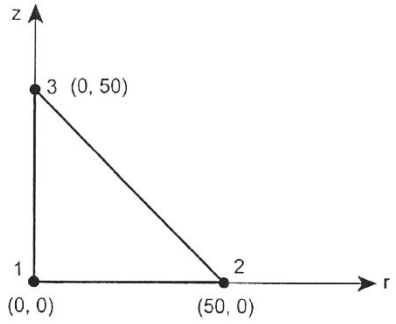
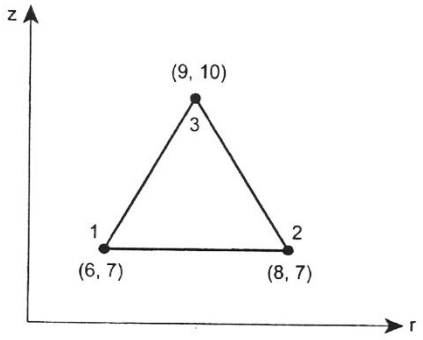
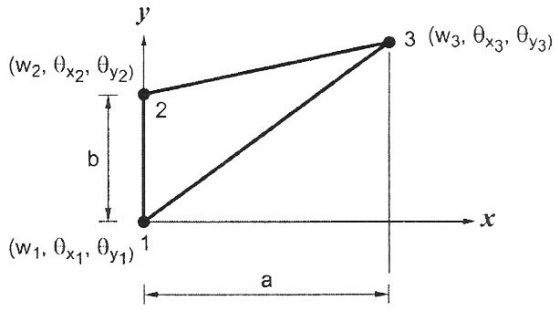
Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.

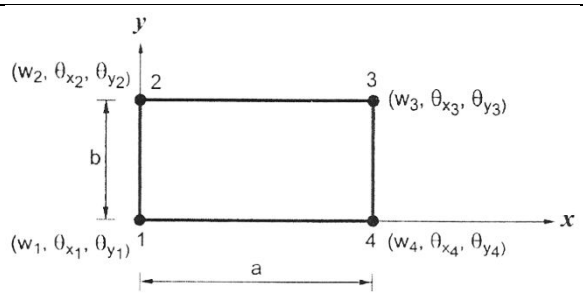
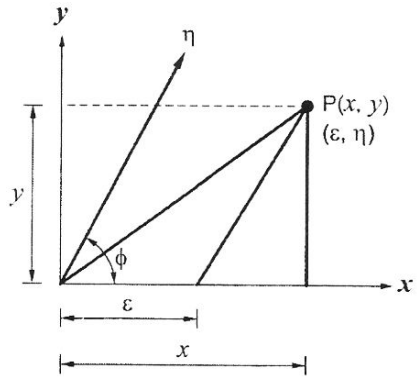
PART – A

CO Mapping : CO613.4

Q.No	Questions	BT Level	Competence	PO
1	What is axisymmetric element?	BTL-1	Remembering	PO1,PO2,PO12
2	What are the conditions for a problem to be axisymmetric?	BTL-1	Remembering	PO1,PO2,PO12
3	Write down the displacement equation for an axisymmetric triangular element.	BTL-3	Applying	PO1,PO2
4	Write down the shape functions for an axisymmetric triangular element.	BTL-3	Applying	PO1,PO2
5	Give the Strain-Displacement matrix equation for an axisymmetric triangular element.	BTL-3	Applying	PO1,PO2
6	Write down the Stress-Strain relationship matrix for an axisymmetric triangular element.	BTL-3	Applying	PO1,PO3
7	Give the stiffness matrix equation for an axisymmetric triangular element.	BTL-3	Applying	PO1,PO3,PO4
8	What are the ways in which a three dimensional problem can be reduced to a two dimensional approach?	BTL-1	Remembering	PO1,PO2
9	Calculate the Jacobian of the transformation J for the triangular element shown in Fig.	BTL-5	Evaluating	PO2,PO3,PO4
10	What are the assumptions used in thin plate element?	BTL-1	Remembering	PO1,PO3,PO4
11	What are the assumptions used in thick plate element?	BTL-1	Remembering	PO2,PO3
12	What are the advantages of shell elements?	BTL-1	Remembering	PO2,PO3,PO4
13	What are the types of shell element?	BTL-1	Remembering	PO1,PO2
14	Define shell element.	BTL-1	Remembering	PO1,PO2,PO4
15	What are the assumptions for thin shell theory?	BTL-1	Remembering	PO1,PO2,PO3
16	Define plate element.	BTL-1	Remembering	PO1,PO2,PO4

17	Define Jacobian.	**BTL-1**	**Remembering**	**PO1,PO2,PO3**
18	Sketch two 3D elements exhibiting linear strain behavior.	**BTL-2**	**Understanding**	**PO1,PO2**
19	What is a vector variable problem?	**BTL-1**	**Remembering**	**PO1,PO2,PO3**
20	Give four applications where axisymmetric elements can be used.	**BTL-3**	**Applying**	**PO1,PO12**
21	What is higher order element?	**BTL-1**	**Remembering**	**PO1,PO3**
22	What are higher order elements and why are they preferred?	**BTL-1**	**Remembering**	**PO1,PO11**
23	What are the two forms to express interpolation functions?	**BTL-1**	**Remembering**	**PO1,PO3**
24	What do you mean by a simplex element?	**BTL-1**	**Remembering**	**PO1,PO2,PO3 ,PO12**
25	What do you mean by complex elements?	**BTL-1**	**Remembering**	**PO1,PO2,PO3 ,PO11,PO12**
26	What do you mean by a multiplex element?	**BTL-1**	**Remembering**	**PO1,PO2,PO4**
27	What is meant by steady state heat transfer? Write down its governing differential equation.	**BTL-1**	**Remembering**	**PO1,PO2,PO3 ,PO4**
28	Mention two natural boundary conditions as applied to thermal problems.	**BTL-4**	**Analyzing**	**PO1,PO2,PO3 ,PO4**
29	Define element capacitance matrix for unsteady state heat transfer problems.	**BTL-1**	**Remembering**	**PO1,PO2,PO4**
30	Write down the conduction matrix for a three noded linear triangular element.	**BTL-1**	**Remembering**	**PO1,PO2,PO4**
	PART – B & C			
1	The nodal co-ordinates for an axisymmetric triangular element are given in figure. Evaluate strain-Displacement matrix for that element. 	**BLT-5**	**Evaluating**	**PO1,PO4,**
2	Determine the stiffness matrix for the	**BTL-5**	**Evaluating**	**PO1,PO2,PO3**

	axisymmetric element shown in figure. Take E = 2.1 x 10^5 N/mm^2, ν = 0.25. The coordinates are in mm. 			
3	Calculate the element stiffness matrix for the axisymmetric triangular element shown in figure. The element experiences a 15°C increase in temperature. The coordinates are in mm. Take α=10×10^{-6}/°C, E=2×10^5 N/mm^2, ν=0.25. 	**BLT-5**	**Evaluating**	**PO1,PO3,PO4**
4	Determine the stiffness matrix for Triangular Plate Bending Element with 9 Degrees of Freedom as shown in figure. 	**BLT-5**	**Evaluating**	**PO1,PO2,PO3 ,PO4**
5	Determine the stiffness matrix for Rectangular Plate Bending Element with 12 Degrees of Freedom as shown in figure.	**BLT-5**	**Evaluating**	**PO1,PO3,PO4**

				
6	Determine the stiffness matrix for Skew Plate shown in figure. 	**BLT-5**	**Evaluating**	**PO1,PO2,PO4 ,PO6**

UNIT V ISOPARAMETRIC FORMULATION

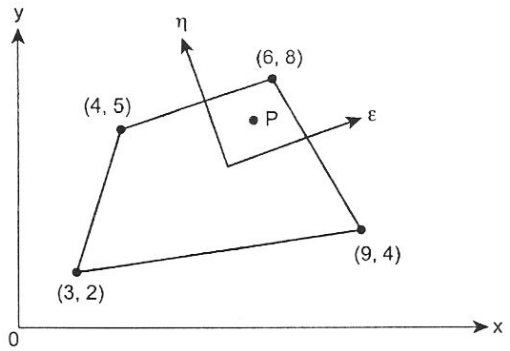
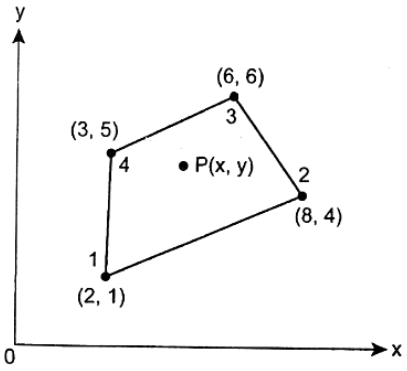
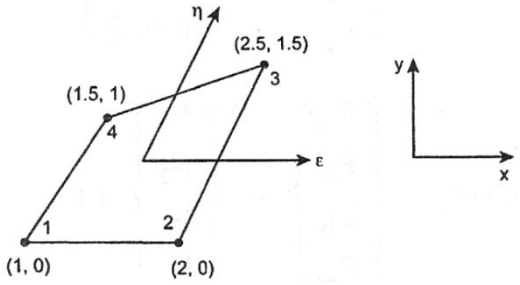
Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.

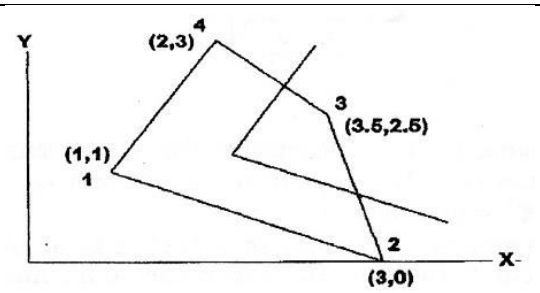
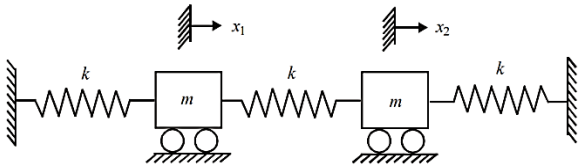
PART – A

CO Mapping : CO613.5

Q.No	Questions	BT Level	Competence	PO
1	Define Jacobian.	BTL-1	Remembering	PO1,PO2,PO4
2	Sketch two 3D elements exhibiting linear strain behavior.	BTL-2	Understanding	PO1,PO2,PO3
3	What is the purpose of Isoparametric elements.	BTL-1	Remembering	PO1,PO2
4	Write down the shape functions for 4 noded rectangular element using natural coordinate system.	BTL-3	Remembering	PO1,PO2,PO3
5	Write down the Jacobian matrix for four noded quadrilateral element.	BTL-3	Remembering	PO1,PO2
6	Write down the stiffness matrix equation for four nodedisoparametric quadrilateral element.	BTL-3	Remembering	PO1,PO2
7	Write down the element force vector equation for four noded quadrilateral element.	BTL-3	Remembering	PO1,PO2,PO3
8	Write down the Gaussian quadrature expression for numerical integration.	BTL-3	Remembering	PO1,PO2,PO12
9	Define superparametric element.	BTL-1	Remembering	PO1,PO2
10	What is meant by subparametric element?	BTL-1	Remembering	PO1,PO3
11	What is meant by Isoparametric element?	BTL-1	Remembering	PO1,PO4
12	Is beam element an isoparametric element?	BTL-5	Evaluating	PO1,PO12
13	What is the difference between natural co-ordinate and simple natural co-ordinate?	BTL-1	Remembering	PO1,PO2,PO3
14	Give examples for essential (forced or geometric) and non-essential (natural) boundary conditions.	BTL-5	Evaluating	PO1,PO2
15	What are the types of non-linearity?	BTL-1	Remembering	PO1,PO2,PO3
16	What are the types of Eigen value problems?	BTL-1	Remembering	PO1,PO3

17	State the principle of superposition.	**BTL-1**	**Remembering**	**PO1,PO12**
18	Define resonance.	**BTL-1**	**Remembering**	**PO1,PO12**
19	Define Dynamic Analysis.	**BTL-1**	**Remembering**	**PO1,PO2,PO11**
20	What are methods used for solving transient vibration problems?	**BTL-1**	**Remembering**	**PO1,PO2**
21	Write down the equation for undamped system of Direct Integration Method in Central Difference Method.	**BTL-3**	**Remembering**	**PO1,PO2,PO12**
22	State the two difference between direct and iterative methods for solving system of equations.	**BTL-1**	**Remembering**	**PO1,PO2,PO3**
23	What is the salient feature of an isoparametric element? Give an example.	**BTL-1**	**Remembering**	**PO1,PO2,PO12**
24	What are the advantages of Natural Co-ordinate system?	**BTL-1**	**Remembering**	**PO1,PO2,PO4**
25	Differentiate global and local coordinates.	**BTL-1**	**Remembering**	**PO1,PO3,PO4**
26	What are the classifications of coordinates?	**BTL-1**	**Remembering**	**PO1,PO2,PO3**
27	What is Global coordinates?	**BTL-1**	**Remembering**	**PO1,PO2,PO4, PO12**
28	What is natural coordinates?	**BTL-1**	**Remembering**	**PO1,PO2,PO4, PO12**
29	What is the influence of element distortion on the analysis results?	**BTL-1**	**Remembering**	**PO1,PO2,PO4, PO12**
30	List the types of dynamic analysis problems.	**BTL-4**	**Analyzing**	**PO1,PO2,PO3**
31	Define normal modes.	**BTL-1**	**Remembering**	**PO1,PO2,PO4**
32	Define Quasi static response.	**BTL-1**	**Remembering**	**PO1,PO2,PO12**
33	What is the purpose of Iso parametric elements?	**BTL-1**	**Remembering**	**PO1,PO2,PO3**
PART – B & C				
1	Evaluate the Cartesian coordinate of the point P which has local coordinates ε=0.6 and η=0.8 as shown in figure.	**BLT-5**	**Evaluating**	**PO1,PO2,PO3 ,PO12**

				
2	For the isoparametric quadrilateral element shown in figure, the Cartesian coordinates of point P are (6,4). The loads 10 kN and 12 kN are acting in x and y directions on that point P. Evaluate the nodal equivalent forces. 	**BLT-5**	**Evaluating**	**PO1,PO2,PO3**
3	Evaluate the Jacobian matrix for the isoparametric quadrilateral element shown in figure. 	**BLT-5**	**Evaluating**	**PO1,PO2,PO12**
4	(a) For the four noded element shown in Figure, determine the Jacobian and evaluate its value at the point (1/3, 1/3).	**BLT-5**	**Evaluating**	**PO1,PO3,PO6**

	 (b) Using energy approach, derive the stiffness matrix for a 1D linear isoparametric element.			
5	(a) Derive the shape functions for all the corner nodes of a nine noded quadrilateral element. (b) Using Gauss Quadrature evaluate the following integral using 1, 2 and 3 point integration. $$\int_{-1}^{1} \frac{\sin s}{-1S(1-s^2)} ds$$	**BLT-5**	**Evaluating**	**PO1,PO2,PO4**
6	Consider the undamped 2 degree of freedom system as shown in figure. Find the response of the system when the first mass alone is given an initial displacement of unity and released from rest.  The mathematical representation of the system for free, Harmonic vibration is given by $$\begin{bmatrix} 2k & -k \\ -k & 2k \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \end{Bmatrix} = \omega^2 \begin{bmatrix} m & 0 \\ 0 & m \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \end{Bmatrix}$$ Find the response of the system given below using modal superposition method. $$2m\ddot{q}_1 + 2kq_1 - kq_2 = 0$$ $$m\ddot{q}_2 + 2kq_2 - kq_1 = 0$$ With the initial conditions at t=0, $$q_1 = 0, \qquad q_2 = 1$$ $$\dot{q}_1 = 0, \qquad \dot{q}_2 = 1$$	**BLT-5**	**Evaluating**	**PO1,PO2,PO4**