SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF CIVIL ENGINEERING

M.E – STRUCTURAL ENGINEERING

QUESTION BANK

SEMESTER - II

ST 3264 - FINITE ELEMENT ANALYSIS IN STRUCTURAL ENGINEERING

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Prepared by

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SRM VALLIAMMAI ENGINEERING COLLEGE
DEPARTMENT OF CIVIL ENGINEERING

SUBJECT CODE: ST 3264
SUBJECT NAME: FINITE ELEMENT ANALYSIS IN STRUCTURAL ENGINEERING

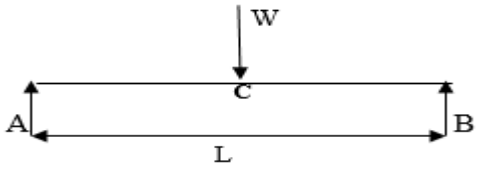
UNIT I - INTRODUCTION

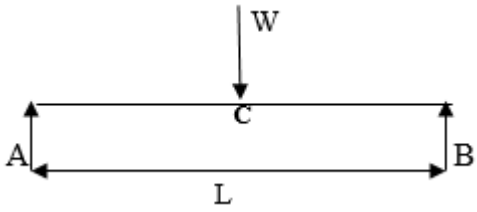
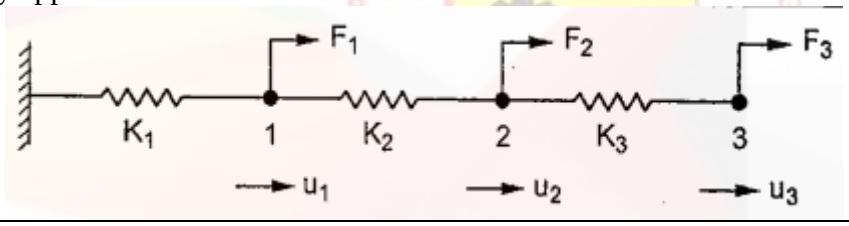
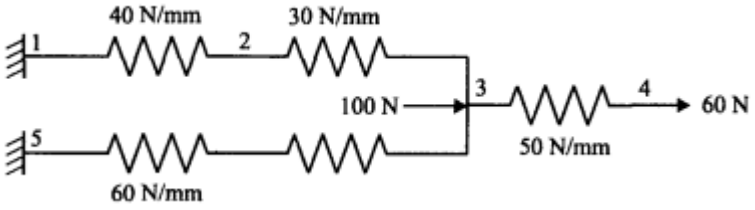
Introduction - Basic Concepts of Finite Element Analysis - Introduction to Elasticity- Steps in Finite Element Analysis - Finite Element Formulation Techniques. Approximate solutions of boundary value problems - Methods of weighted residuals, virtual work method, Modified Galerkin method, Boundary conditions and general comments continuity, compatibility, convergence aspects - PSTP – Matrix algebra.

PART-A

S.No.	Questions	BT Level	Competence
1	What is meant by finite element analysis?	BT-1	Remembering
2	Why FEM/FEA is necessary?	BT-1	Remembering
3	What are all the information available from various types of FEM Analysis?	BT-1	Remembering
4	What are all the advantages and disadvantages of FEM?	BT-1	Remembering
5	List the various finite element method (Approximate Methods).	BT-1	Remembering
6	What is the difference between static and dynamic analysis?	BT-1	Remembering
7	Discuss the evolution of FEM/FEA.	BT-1	Remembering
8	Discuss about the general methods of FEM/FEA.	BT-1	Remembering
9	Sketch the flow chart of FEA procedure.	BT-2	Understanding
10	Define discretization.	BT-1	Remembering
11	Define assemblage in FEM.	BT-1	Remembering
12	State the three phases of finite element method.	BT-1	Remembering
13	Name any 5 FEM software.	BT-1	Remembering
14	Write the objective of FEM/FEA.	BT-1	Remembering
15	Differentiate structural and non structural problems.	BT-2	Understanding
16	Differentiate static and dynamic analysis.	BT-2	Understanding
17	Differentiate between global and local axes.	BT-2	Understanding
18	Brief about various errors in FEM.	BT-1	Remembering
19	Define the term weak formulation.	BT-1	Remembering
20	Formulate a trial solution for the simply supported beam of length, '*l*' subjected to an uniformly distributed load,'w' kN/m throughout its length.	BT-3	Applying
21	Enlist the common applications of FEA.	BT-1	Remembering
22	Find the eigen values of $\text{matrix } A = \begin{pmatrix} 4 & 7 \\ 0 & 2 \end{pmatrix}$	BT-3	Applying
23	Enlist the limitations of FEA.	BT-1	Remembering
24	During discretization, mention the places where it is necessary to place a node?	BT-1	Remembering

PART-B

1	Discuss the advantages, disadvantages and applications of FEA.	BT-2	Understanding
2	Discuss about the historic background behind FEM/FEA development?	BT-2	Understanding
3	Briefly describe the basic steps in finite element analysis.	BT-2	Understanding
4	Discuss about the a) Classification of FEM. b) Types of Analysis in FEM c) Principle of Minimum potential Energy	BT-2	Understanding
5	Distinguish between a) FEM and Classic Methods b) FEM and FDM	BT-2	Understanding
6	Discuss the Engineering Applications of the Finite Element Method.	BT-2	Understanding
7	Find the Eigen value and eigen function of $y'' - 4\lambda y' + 4\lambda^2 y = 0$; with the boundary conditions are $y'(1) = 0$, $y(2) + 2y'(2) = 0$.	BT-4	Analyze
8	The following differential equation is available for a physical phenomenon $AE(d^2y/dx^2+q_0) = 0$ with the boundary conditions as $y(0) = 0$ & $(dy/dx)_{x= L} = 0$. Find the value of f(x) using the weighed residual method.	BT-4	Analyze
9	The following differential equation is available for a physical phenomenon $(d^2y / dx^2) -10x^2=5$, $0 \le x \le 1$. Trial function is $N_1 = x(x-1)$ $N_2 = x^2(x-1)$. Boundary conditions are $y(0) = 0$; $y(1)=0$. Obtain two term Galerkin solution by using trail function.	BT-4	Analyze
10	A beam AB of span 'l' simply supported at ends and carrying a concentrated load W at the centre 'C' as shown in fig. Determine the deflection at mid span by using Rayleigh-Ritz method and compare with exact solution.  	BT-4	Analyze
11	Solve the differential equation for a physical problem which is expressed as $d^2y/dx^2 + 50 = 0$, $0 \le x \le 10$ with the boundary conditions as $y(0) = 0$ and $y(10) = 0$ using the trial function $y = a_1x(10-x)$ find the value of the parameters a_1 by the following methods listed below a) Point collocation method b) Sub domain collocation method c) Least squares method d) Galerkin method.	BT-4	Analyze
12	A simply supported beam of span L, young's modulus, moment of inertia I is subjected to a uniformly distributed load of P/unit length. Determine the deflection W at the mid-span by the following methods listed below a) Point collocation method b) Sub domain collocation method c) Least squares method d) Galerkin method.	BT-4	Analyze

13	The following differential equation is available for a physical phenomenon $(d^2y / dx^2) +500x^2 = 0$, $0 \le x \le 1$. Trial function is $y = a_1 (x-x^4)$. Boundary conditions are y(0) = 0; y(1)=0. Find the value of the parameter a1 by the following methods: a) Point Collocation b) Sub Domain c) Least Square d) Galerkin method.	BT-4	Analyze
14	Find the deflection of a clamped beam subjected to UDL throughout its length. Use point collocation method. Take trail function as $y= a (x^5 - 2 lx^4 + l^2x^3)$	BT-4	Analyze
15	A simply supported beam of span L, young's modulus, moment of inertia I is subjected to a uniformly distributed load of P/unit length. Determine the deflection at the mid-span. Use Rayleigh Ritz method.	BT-4	Analyze
16	A beam AB of span 'l' simply supported at ends and carrying a concentrated load W at the centre 'C' as shown in fig. Determine the deflection at mid span by using Finite difference method and compare with exact solution. 	BT-4	Analyze
17	Assemble finite element equation by using direct approach and potential energy approach. 	BT-4	Analyze
18	Determine the displacements of nodes of the spring system 	BT-4	Analyze

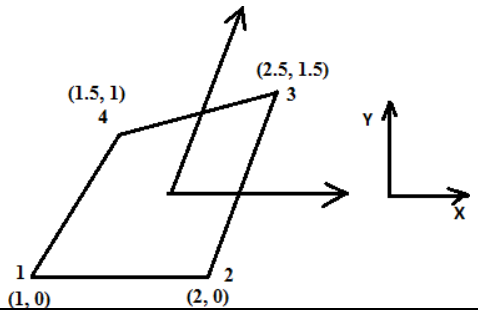
UNIT II – ELEMENT PROPERTIES

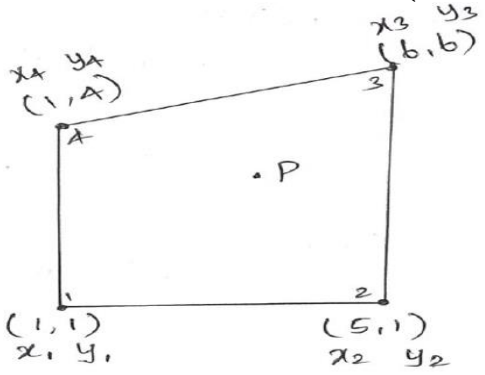
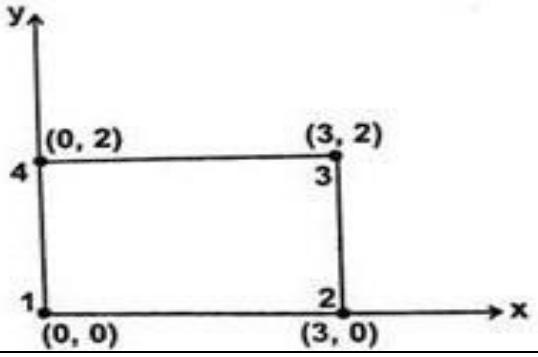
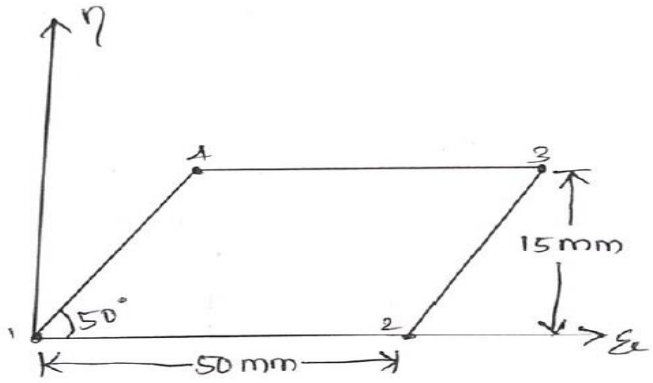
Natural Coordinates - Triangular Elements - Rectangular Elements - Lagrange and Serendipity Elements - Solid Elements - Isoparametric Formulation - Stiffness Matrix of Isoparametric Elements - Numerical Integration: One, Two and Three Dimensional - Problems.

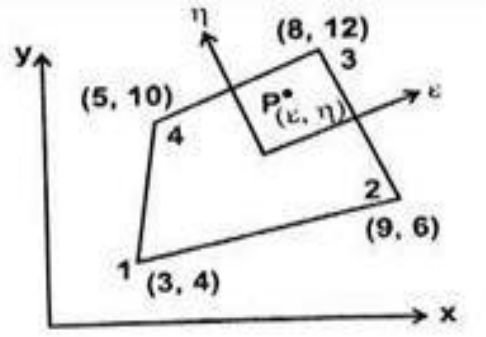
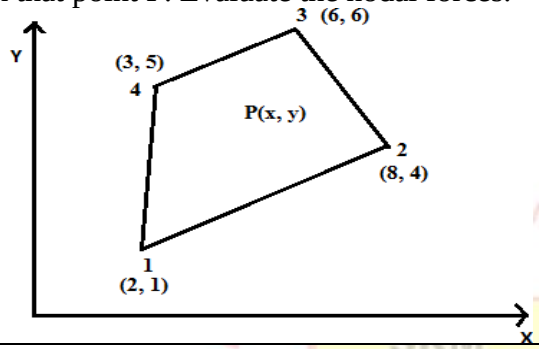
PART-A

Q. No.	Questions	BT Level	Competence
1.	What are the types of Elements used in FEA?	BT-1	Remembering
2.	Sketch the element shapes for simple, complex and multiplex category of elements.	BT-3	Applying
3.	Enlist the properties of stiffness matrix.	BT-1	Remembering
4.	Define the terms 'Plane stress' and 'Plane strain' problems.	BT-1	Remembering
5.	Write about internal and External nodes.	BT-1	Remembering
6.	Differentiate Lagrange rectangle and Serendipity rectangles.	BT-2	Understanding
7.	Distinguish between 1-D and 2-D elements.	BT-2	Understanding
8.	Tell about Nodes, primary nodes, secondary nodes and internal nodes	BT-1	Remembering
9.	Interpret Local coordinates, global coordinates, natural coordinates and area coordinates.	BT-1	Remembering
10.	State the difference between natural coordinate and simple natural coordinate.	BT-1	Remembering
11.	Differentiate isoperimetric, super parametric and sub parametric elements.	BT-2	Understanding
12.	Determine the value of $\int_0^1 L_1^3 dx$	BT-3	Applying
13.	Give the standard closed form integration over entire length for 1-D element.	BT-1	Remembering
14.	Give the standard closed form integration over entire length for 2-D element.	BT-1	Remembering
15.	Define jacobian transformation.	BT-1	Remembering
16.	Draw the Pascal's triangle.	BT-3	Applying
17.	List the advantages of Gauss quadrature method.	BT-1	Remembering
18.	Define isoparametric formulation.	BT-1	Remembering
19.	What are 'p' and 'h' versions of finite element method?	BT-1	Remembering
20.	Why polynomials are generally used as shape function?	BT-1	Remembering
21.	Define First order continuity problems.	BT-1	Remembering
22.	Give the stiffness matrix for a beam element.	BT-1	Remembering
23.	With 5 nodes, frame various combination of elements and mention the type of nodes	BT-1	Remembering
24.	Give Euler-Lagrange equation.	BT-1	Remembering

PART-B

<table>
<tr><td>1.</td><td>Discuss about
a) Degrees of Freedom for Various Elements
b) Lagrange and Serendipity Elements</td><td>BT-2</td><td>Understanding</td></tr>
<tr><td>2.</td><td>Tabulate
a) Types of Analysis
b) Response parameters for different cases
c) Stress on typical element</td><td>BT-2</td><td>Understanding</td></tr>
<tr><td>3.</td><td>a) Using generalized coordinate approach, find shape functions for two noded bar/truss element.
b) Using polynomial functions (generalized coordinates) determine shape functions for a two noded beam element.</td><td>BT-3</td><td>Applying</td></tr>
<tr><td>4.</td><td>Discuss about coordinate systems with examples.</td><td>BT-2</td><td>Understanding</td></tr>
<tr><td>5.</td><td>Explain the following terms
a) Nodes, primary nodes, secondary nodes and internal nodes
b) Local coordinates, global coordinates, natural coordinates and area coordinates.
c) Higher order elements and lower order elements.</td><td>BT-2</td><td>Understanding</td></tr>
<tr><td>6.</td><td>Derive the displacement function U, shape function N and stiffness matrix for 1-D linear bar element.</td><td>BT-3</td><td>Applying</td></tr>
<tr><td>7.</td><td>Derive shape function for a beam element.</td><td>BT-3</td><td>Applying</td></tr>
<tr><td>8.</td><td>Derive an expression for natural coordinates in 2-D.</td><td>BT-3</td><td>Applying</td></tr>
<tr><td>9.</td><td>Determine the values of
<table>
<tr><th>Natural Coordinates for 1-D Elements</th><th>Natural Coordinates for 2-D Elements</th><th>Natural Coordinates for 3-D Elements</th></tr>
<tr><td>(i) $\int_o^l L_1^2\ dx$
(ii) $\int_o^l L_1^3\ L_2\ dx$</td><td>(i) $\oint_A L_1\ L_2\ L_3\ dA$
(ii) $\oint_A L_1^3\ L_2\ dA$
(iii) $\oint_A L_1^2\ L_2^2\ L_3^3\ dA$</td><td>(i) $\oint_V L_1\ L_2\ L_3\ L_4\ dV$
(ii) $\oint_V L_1^2\ L_2\ L_4\ dV$</td></tr>
</table></td><td>BT-4</td><td>Analyze</td></tr>
<tr><td>10.</td><td>Evaluate the Jacobian matrix for the isoparametric quadrilateral element shown in figure below.
 
</td><td>BT-4</td><td>Analyze</td></tr>
</table>

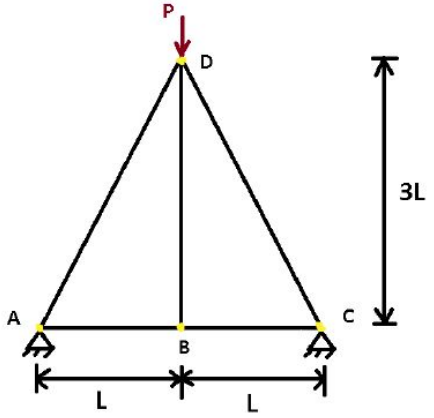
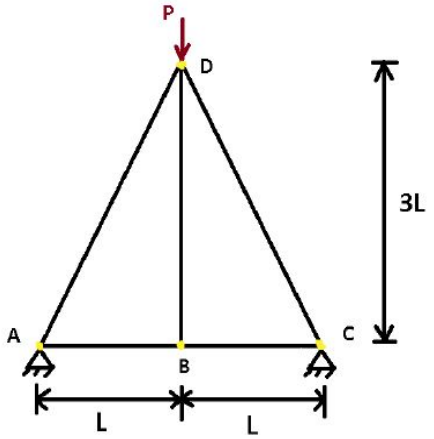
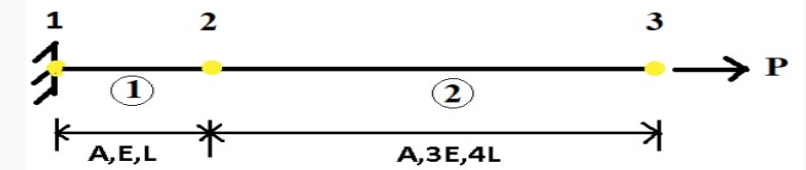
11.	For a four noded rectangular element shown in fig., determine the cartesian co-ordinates of point P which has local coordinates (0.5,0.5)  	BT-4	Analyze
12.	For a four noded rectangular element shown in fig. Estimate the following a. Jacobian matrix b. Strain-Displacement matrix c. Element stress.  	BT-4	Analyze
13.	Consider a quadrilateral elemnt as shown in figure. the local coordinates are (0.5,0.5). Evalaute the jacobian matrix and strain displacement matrix.  	BT-4	Analyze

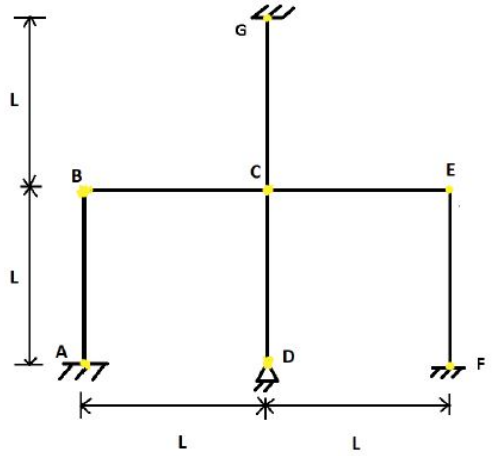
14.	Calculate the Cartesian coordinates of the point P which has local coordinates ε = 0.8 and η = 0.6 as shown in figure 	BT-4	Analyze
15.	For the isoparametric quadrilateral element shown in figure, the Cartesian coordinates of point 'P', are (6,4). The loads 10 kN and 12 kN are acting in x and y direction on that point P. Evaluate the nodal forces. 	BT-4	Analyze
16.	Evaluate below expression (I) by 3 point gaussian quadrature a) $\int_{-1}^{1}(x^4+x^2)dx$ b) $\int_{-1}^{1}(x^4-3x+7)dx$	BT-4	Analyze
17.	Evaluate below expression (I) by 2 point gaussian quadrature a) $\int_{-1}^{1}x^2dx$ b) $I=\int_{-1}^{1}2+x+x^2dx$	BT-4	Analyze
18.	Evaluate below expression by 3 point gaussian quadrature a) $I=e^{-x}dx$ b) $I=[x^2+cos(x/2)]dx$	BT-4	Analyze

UNIT III - ANALYSIS OF BEAMS AND RIGID FRAMES

Discritization of a Structure - Shape Function - Analysis of Beams - Stiffness of Beam Members - Analysis of Truss - Stiffness of Truss Members.
Analysis of Rigid Frames - Finite Element Analysis of Continuous Beam - Plane Frame Analysis - Analysis of Grid and Space Frame - Assembling stiffness equations.

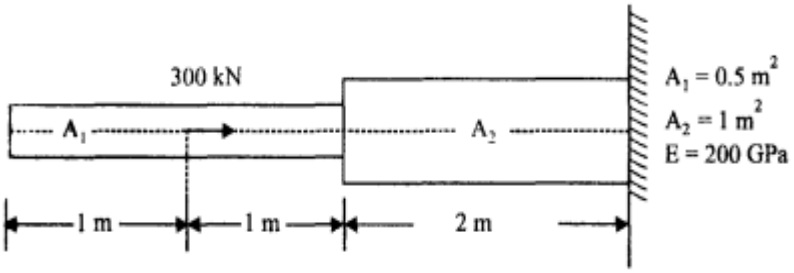
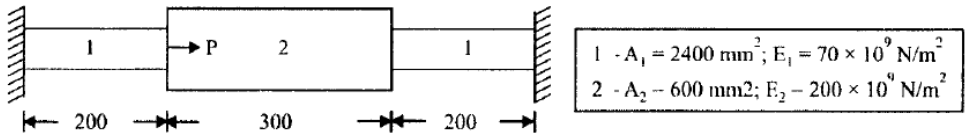
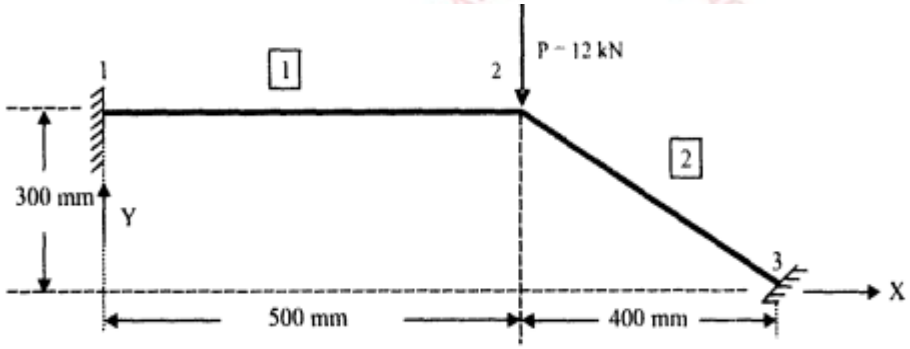
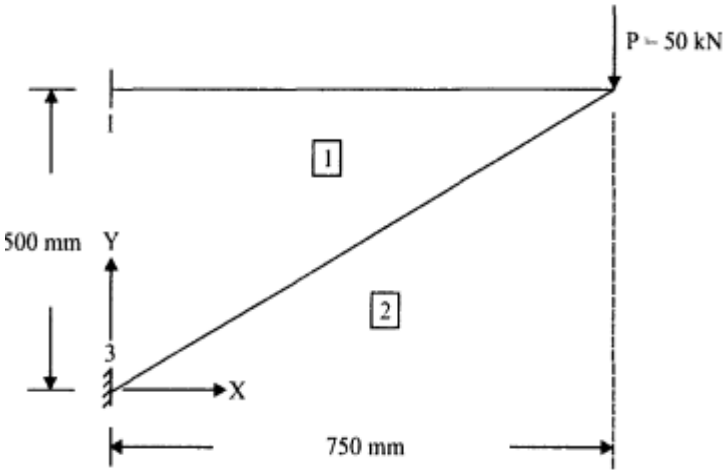
PART A

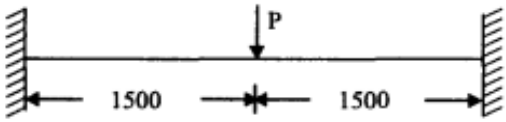
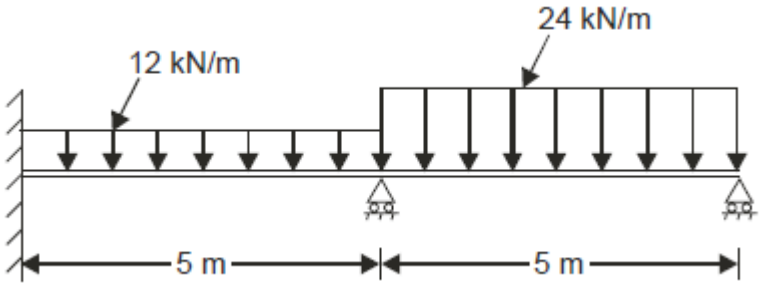
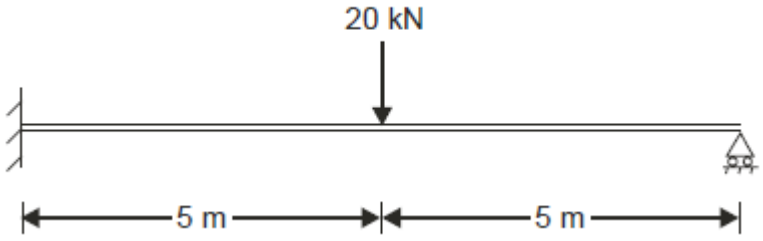
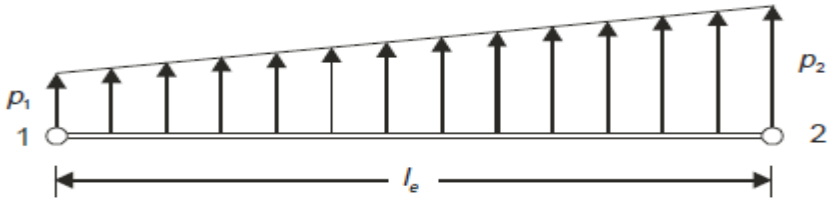
1	Write down the shape functions for 4 noded rectangular elements using natural coordinate system.	BT-1	Remembering
2	Define Timoshenko Beam Theory.	BT-1	Remembering
3	Determine the dimension of global stiffness matrix for the given structure 	BT-3	Applying
4	Determine the stiffness matrix for the element CD. 	BT-3	Applying
5	Show the global stiffness matrix for the bar shown below 	BT-3	Applying
6	Draw 2-D Lagrange elements and pascal triangle.	BT-3	Applying
7	Draw 2-D rectangular elements and pascal triangle.	BT-3	Applying
8	Give the element stiffness matrix for varying cross section.	BT-1	Remembering
9	Define discretization of a structure.	BT-1	Remembering

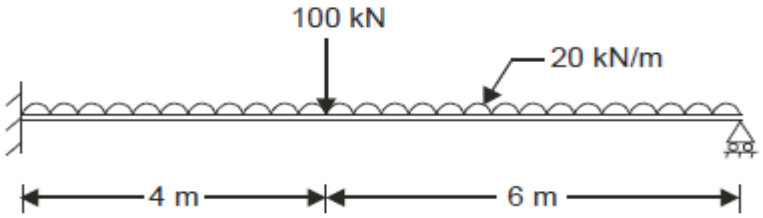
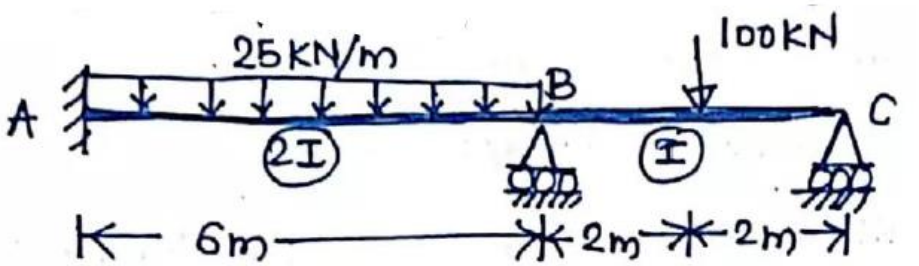
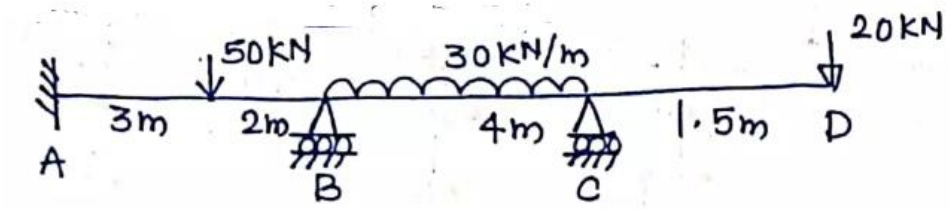
10	For the frame shown below, identify the number of degrees of freedom and dimension of a global stiffness matrix.  	BT-3	Applying
11	Distinguish between essential boundary conditions nad natural boundary conditions.	BT-2	Understanding
12	Write the expression for tranverse vibration of a beam element.	BT-1	Remembering
13	Give the expression of element stiffness for a 3 node truss member.	BT-1	Remembering
14	Define pipe element.	BT-1	Remembering
15	Differentiate simplex, complex and multiplex elements.	BT-2	Understanding
16	Give stress resultant curvature matrix.	BT-1	Remembering
17	Define the term 'shear locking'.	BT-1	Remembering
18	Give the generalized stiffness matrix of a plane truss member.	BT-1	Remembering
19	Give the generalized stiffness matrix of a beam member.	BT-1	Remembering
20	Give the stiffness matrix of a continuous beam.	BT-1	Remembering
21	Discuss the finite element analysis of continuous beams advantages over traditional methods of analysis.	BT-1	Remembering
22	Brief the process of plane frame analysis and highlight its key components.	BT-1	Remembering
23	What is the significance of assembling stiffness equations in structural analysis, and how is it performed?	BT-1	Remembering
24	What are shape functions in the context of finite element analysis?	BT-1	Remembering

PART B

1	Draw the flow chart of assembly of stiffness local matrix to global matrix.	BT-3	Applying
2	Derive shape function for a beam element.	BT-3	Applying
3	Derive the stiffness matrix (Direct method) for a) Bar Element b) Beam Element	BT-3	Applying
4	Derive the stiffness matrix (Direct method) for a) Truss Element b) Torsion Element	BT-3	Applying
5	Explain Timoshenko Beam Theory. Discuss its advantages and disadvantages.	BT-3	Applying
6	Determine the nodal displacements and element stresses by finite element	BT-4	Analyze

	formulation for the following figure. Use P=300 k N; A,=0.5 m^2 ; A2=1 m^2 ; E=200 GPa  		
7	An axial load P=200x 10^3 N is applied on a bar as shown. Using the penalty approach for handling boundary conditions, determine nodal displacements, stress in each material and reaction forces.  	BT-4	Analyze
8	Determine the nodal displacements, element stresses and support reactions in the truss structure shown below, assuming points 1 and 3 are fixed. Use E = 70 GPa and A = 200 mm^2  	BT-4	Analyze
9	Determine the stiffness matrix, stresses and reactions in the truss structure shown below, assuming points 1 and 3 are fixed. Use E = 200 GPa and A = 1000 mm^2  	BT-4	Analyze
10	A concentrated load P = 50 kN is applied at the center of a fixed beam of	BT-4	Analyze

	length 3m, depth 200 mm and width 120 mm. Calculate the deflection and slope at the mid point. Assume E = 2 x 10^5 N/mm^2 		
11	Consider the truss element with the coordinates I (10,10) and 2 (50,40). If the displacement vector is q=[15 10 21 43]T mm, then determine (i) the vector q' (ii) stress in the element and (iii) stiffness matrix if E=70 GPa and A=200 mm^2	BT-4	Analyze
12	Analyse the beam shown in Fig. by finite element method and determine the end reactions. Also determine the deflections at mid spans given E = 2 × 10^5 N/mm^2 and I = 5 × 10^6 mm^4 	BT-4	Analyze
13	A beam of length 10 m, fixed at one end and supported by a roller at the other end carries a 20 kN concentrated load at the centre of the span. By taking the modulus of elasticity of material as 200 GPa and moment of inertia as 24 × 10^{-6} m^4, determine: 1. Deflection under load 2. Shear force and bending moment at mid span 3. Reactions at supports 	BT-4	Analyze
14	Derive the expression for constant load, which varies linearly from *p*1 at node 1 to *p*2 at node 2 on a beam element of length *le*. 	BT-4	Analyze
15	Determine the consistent nodal vector due to loads acting on the beam	BT-4	Analyze

	shown in Fig. below  		
16	Give the step-by-step procedure for solving solution of continuous beam by FEA.	BT-2	Understanding
17	Solve the continuous beam shown below  	BT-4	Analyze
18	Solve the continuous beam shown below  	BT-4	Analyze

UNIT IV - TWO- AND THREE-DIMENSIONAL SOLIDS

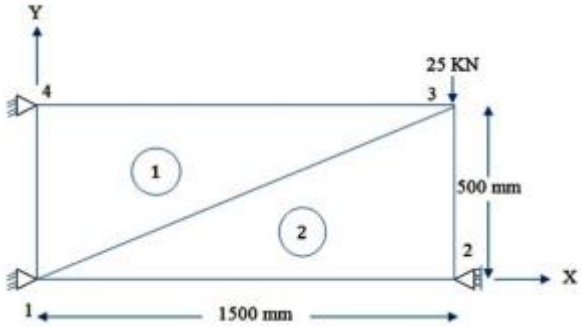
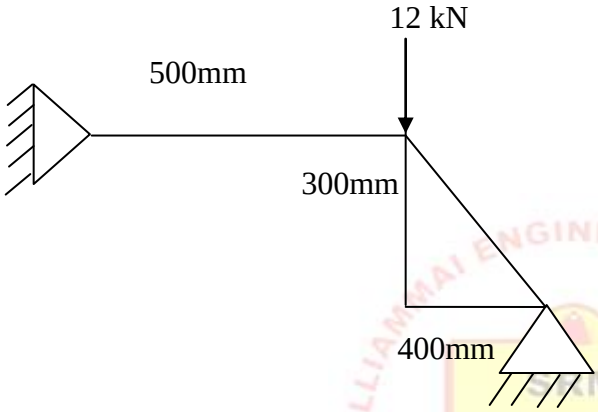
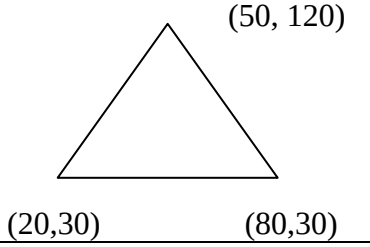
Constant Strain Triangle - Linear Strain Triangle - Rectangular Elements- Numerical Evaluation of Element Stiffness - Computation of Stresses, Geometric Nonlinearity and Static Condensation - Axisymmetric Element - Finite Element Formulation of Axisymmetric Element - Finite Element Formulation for 3 Dimensional Elements- Problems.

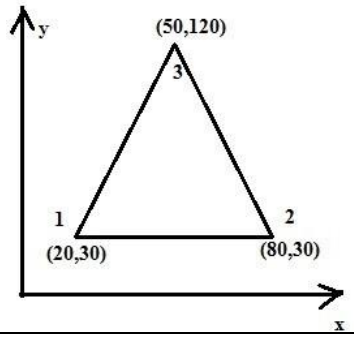
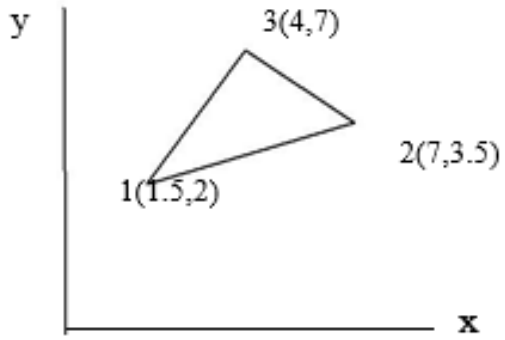
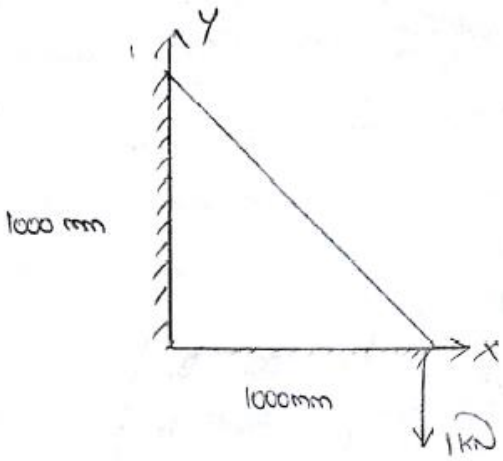
PART-A

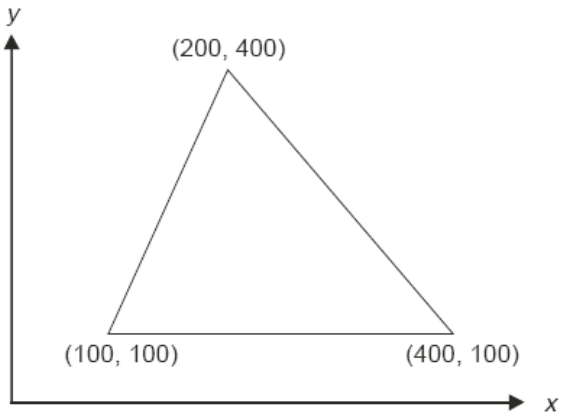
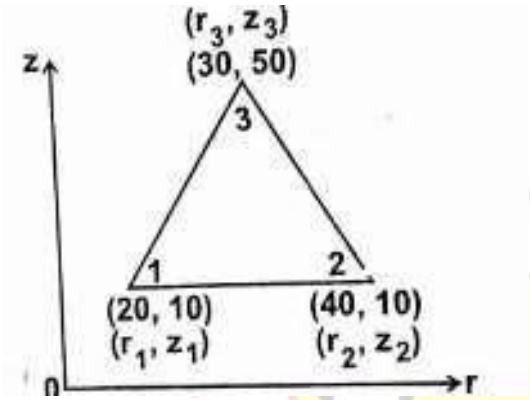
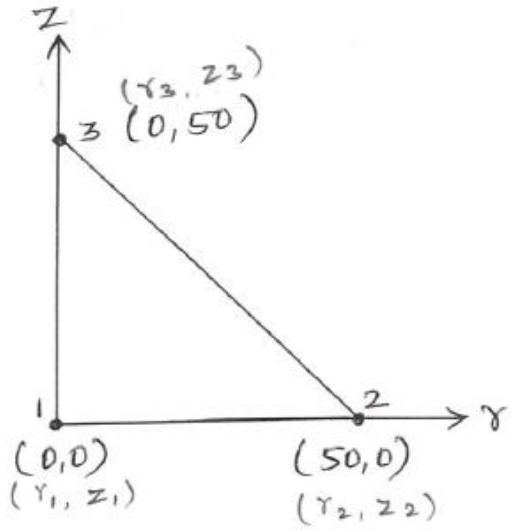
Q. No.	Questions	BT Level	Competence
1	Explain the terms, 'Anisotropic', 'Orthotropic' and 'Isotropic' as applied to material properties.	BT-1	Remembering
2	Differentiate between geometric and material non-linearity.	BT-2	Understanding
3	What are axis-symmetry elements?	BT-1	Remembering
4	What is a CST element?	BT-1	Remembering
5	What is a LST element?	BT-1	Remembering
6	What is a QST element?	BT-1	Remembering
7	What meant by plane stress analysis?	BT-1	Remembering
8	Define plane strain analysis.	BT-1	Remembering
9	Write displacement equation for CST Elemnt.	BT-1	Remembering
10	Write a strain displacement matrix for CST element.	BT-1	Remembering
11	What is the shape fuction equations for an axis- symmetric element?	BT-1	Remembering
12	Differentiate between CST and LST.	BT-1	Remembering
13	Give the expression for shape function of CST element.	BT-1	Remembering
14	State the conditions to be satisfied in order to use axisymmetric elements.	BT-1	Remembering
15	What are the ways in which 3D problem can be reduced to a 2D approach?	BT-1	Remembering
16	Give four applications where axis- symmetric elements can be used.	BT-1	Remembering
17	Write down the displacement equation for an axisymmetric element?	BT-1	Remembering
18	Give the stress-strain relationship matrix for an axis-symmetric triangular element.	BT-1	Remembering
19	Write the stress-strain relation matrix for plane stress condition.	BT-1	Remembering
20	Write the stress-strain relation matrix for plane strain condition.	BT-1	Remembering
21	Define static condensation.	BT-1	Remembering
22	Write short notes about Mesh refinement vs higher order elements.	BT-1	Remembering
23	Discuss about Numbering nodes for band width minimization	BT-1	Remembering
24	Define aspect ratio in FEM.	BT-1	Remembering

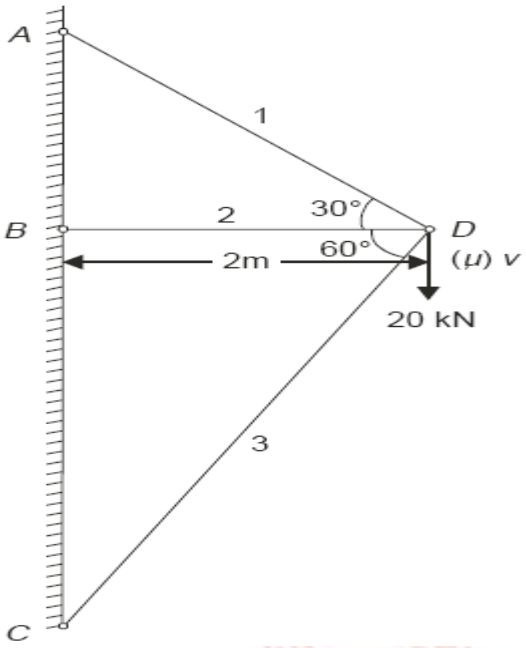
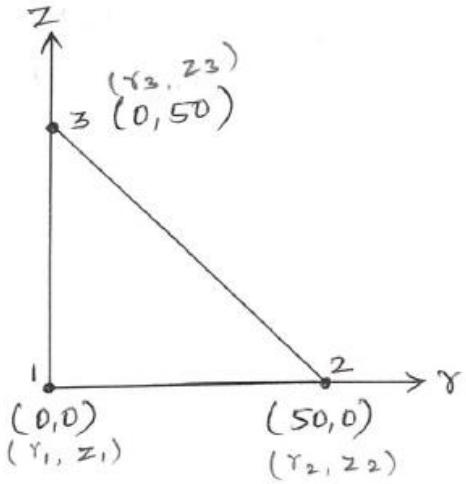
PART –B

1	Determine the displacements at the nodes for the following 2D solid continuum considering a constant thickness of 25 mm, Poisson's ratio, μ as 0.25 and modulus of elasticity E as 2 x 10^5 N/mm^2 . The continuum is	BT-4	Analyze

	discritized with two CST plane stress elements. 		
2	For the two bar truss shown in fig, determine the displacement of node 1 and stress in element 1-3. E = 70Gpa, A = 200mm^2 	BT-4	Analyze
3	Give the steps to be followed in analyzing bar/beam element.	BT-3	Applying
4	Derive the shape function of 4 noded rectangular parent element by natural coordinates system and coordinate transformation.	BT-3	Applying
5	Derive the stiffness matrix for 2-noded bar element.	BT-3	Applying
6	Derive the shape function for CST element.	BT-3	Applying
7	Derive the strain - Displacement matrix for CST Element.	BT-3	Applying
8	Derive the stiffness matrix for the constant strain triangular element (CST) element shown in fig. the coordinates are given in units of millimeters. Assume plane stress conditions. Take E = 210GPa, υ = 0.25, t= 10mm. 	BT-3	Applying
9	For the plane stress element shown in the figure, the nodal displacements are u_1=2 mm, v_1=1 mm, u_2=0.5 mm, v_2=0 mm, u_3=3 mm and v_3=1 mm. Determine the element stresses σ_x, σ_y,τ_{xy}, σ_1, σ_2 and the principal angle Θ_p. Let E=210 Gpa, μ=0.25 and t=10 mm. All coordinates are in mm.	BT-4	Analyze

			
10	Evaluate the shape functions N1, N2, N3 at the interior point P (3.85, 4.8) for the triangular element shown in fig . 	BT-4	Analyze
11	Analyze the truss shown below and calculate nodal displacement and forces if the elemnt stiffness of truss is 10 kN/mm 	BT-4	Analyze
12	For the CST element shown in Fig. 12.7, assemble strain–displacement matrix. Take, t = 20 mm, E = 2×10^5 N/mm^2.	BT-4	Analyze

			
13	The nodal coordinates for an axisymmetric triangular element shown in figure are given below. Evaluate the strain-displacement matrix for that element. 	BT-4	Analyze
14	Derive the shape function of axis-symmetry Element.	BT-3	Applying
15	For an axisymmetric triangular element shown in figure, determine the element stresses. Take E = 210Gpa and Poison's ratio = 0.25  The nodal displacement are u_1= 0.05 mm, u_2 = 0.02 mm,u_3 = 0 mm, w_1 = 0.03 mm, w_2 = 0.02 mm and w_3 = 0 mm.	BT-4	Analyze

16	Using virtual displacement principle, determine the forces developed in the three bar truss shown in Fig. 	BT-4	Analyze
17	Show that the condition that first variance of total potential energy is stationary, is equivalent to satisfying equilibrium equation and boundary conditions in case of (i) Simply supported beam subjected to udl. (ii) Cantilever beam subjected to udl.	BT-3	Applying
18	For an axisymmetric triangular element shown in figure, determine the stiffness matrix. Take E = 210Gpa and Poison's ratio = 0.25  "All coordinates are in millimeters"	BT-4	Analyze

UNIT V - APPLICATIONS OF FEM

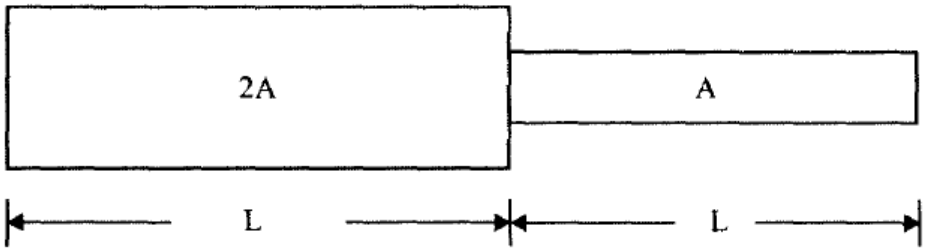
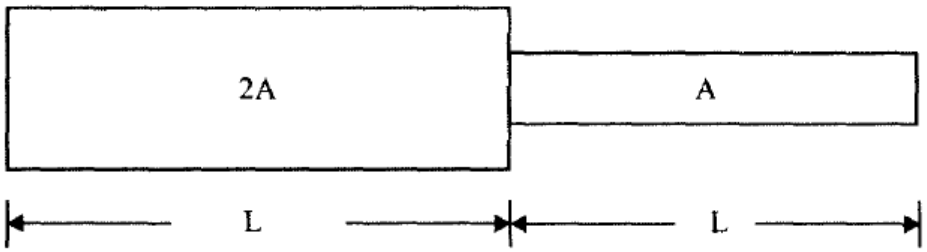
Introduction to Plate Bending Problems - Finite Element Analysis of Thin Plate – Finite Element Analysis of Thick Plate - Finite Element Analysis of Skew Plate - Finite Strip Method - Finite Element Analysis of Shell - Finite Elements for Elastic Stability – Dynamic Analysis - Structure of a FEA Software Program.

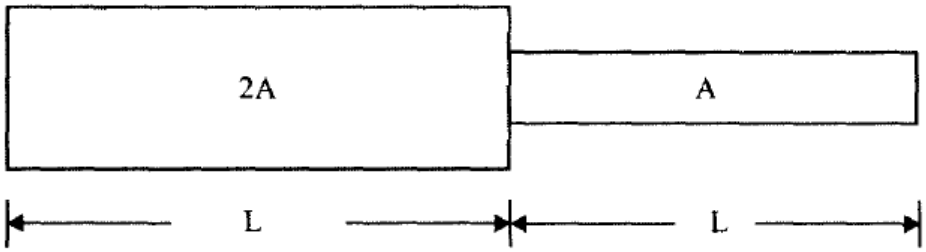
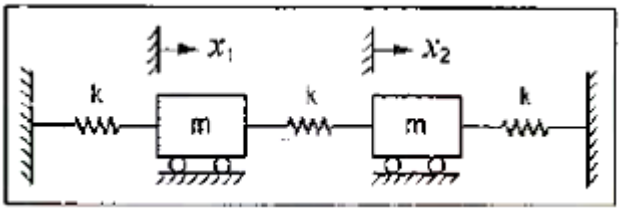
PART – A

Q. No.	Questions	BT Level	Competence
1.	What is a plate element?	BT-1	Remembering
2.	What are the advantages of shell element?	BT-1	Remembering
3.	Write any two boundary conditions for thick plate theory.	BT-1	Remembering
4.	What are the three categories of displacement models for plate analysis?	BT-1	Remembering
5.	Write the basic relationships of thin plate element.	BT-1	Remembering
6.	Write the advantages of finite strip method.	BT-1	Remembering
7.	What are the assumptions for thin shell theory?	BT-1	Remembering
8.	Write the theory of kirchhoff plate element.	BT-1	Remembering
9.	Differentiate thin and thick plates.	BT-2	Understanding
10.	Define shell. Write the types of shells.	BT-1	Remembering
11.	Discuss about Curved shell element.	BT-1	Remembering
12.	What is flat shell element?	BT-1	Remembering
13.	What are the assumptions of Reissner Mindlin Thick Plate theory?	BT-1	Remembering
14.	Enlist the four different approaches used to generate shell elements.	BT-1	Remembering
15.	What are the types of meshes?	BT-1	Remembering
16.	List out the meshing techniques.	BT-1	Remembering
17.	Give two examples of geometric nonlinear problems.	BT-1	Remembering
18.	List the sources of errors in finite element analysis.	BT-1	Remembering
19.	What is the difference between h and p methods?	BT-1	Remembering
20.	What is discretization error?	BT-1	Remembering
21.	What is weak formulation?	BT-1	Remembering
22.	What are the types of non-linearity?	BT-1	Remembering
23.	List out any 4 software used for FEM analysis.	BT-1	Remembering
24.	Write about modal matrix and spectral matrix.	BT-1	Remembering

PART –B

1.	Describe in detail about the Reissner - Mindlin thick plate theory.	BT-2	Understanding
2.	Discuss about finite strip method.	BT-2	Understanding
3.	Describe the element stiffness matrix for thin plate theory.	BT-2	Understanding
4.	Explain the Strain Displacement Relation of thick plate.	BT-2	Understanding
5.	Discuss about a) Membrane response vs Bending response b) Plate vs Shell c) Kirchhoff's plate bending theory vs Reissner - Mindlin plate theory	BT-2	Understanding

6.	Discuss about a) Flat shell, b) Curved shell, c) Solid shell d) Degerated shell elements.	BT-2	Understanding
7.	Derive the stiffness matrix for a rectangular plate bending element with 12 degrees of freedom.	BT-3	Applying
8.	Derive the stiffness matrix for a triangular plate bending element with 9 degrees of freedom.	BT-3	Applying
9.	a) Find the natural frequencies of vibrations of a simple cantilever beam. b) How mass matrix differs from the stiffness matrix. c) Explain the different types of non-linearities encountered in structural analysis	BT-2	Understanding
10.	Write the expression for a) Lumped mass matrix of truss element b) Lumped mass matrix of plane truss element c) Lumped mass matrix of a beam element d) Lumped mass matrix of a CST element	BT-3	Applying
11.	Give the structure of FEA software program.	BT-2	Understanding
12.	Write the expression for a) Consistent mass matrix of a Truss element along its axis b) Consistent mass matrix of a Plane Truss element c) Consistent mass matrix of a Space Truss element d) Consistent mass matrix of a Beam element e) Consistent mass matrix of a CST element in a 2-D plane	BT-3	Applying
13.	Find the natural frequencies of longitudinal vibrations of the unconstrained stepped shaft of areas A and 2A and of equal lengths (L), as shown below. 	BT-3	Applying
14.	Find the natural frequencies of longitudinal vibrations of the same stepped shaft of areas A and 2A and of equal lengths (L), when it is constrained at one end, as shown below. 	BT-3	Applying
15.	Find the natural frequencies of longitudinal vibrations of the constrained stepped shaft of areas A and 2A and of equal lengths (L), as shown below. Compare the results obtained using lumped mass matrix approach and	BT-3	Applying

	consistent mass matrix approach. 		
16.	Find the response of the system shown below when the first mass alone is given an initial displacement of unity and released from rest. 	BT-3	Applying
17.	Discuss the techniques of saving computer memory requirements.	BT-2	Understanding
18.	Explain the Analysis Software based on the structure of a FEA program.	BT-2	Understanding