Course Code: 18CE0137 **R18**

SIDDARTHA INSTITUTE OF SCIENCE AND TECHNOLOGY:: PUTTUR
(AUTONOMOUS)
Siddharth Nagar, Narayanavanam Road – 517583

QUESTION BANK (DESCRIPTIVE)

Subject with Code: Finite Element Method (18CE0137) **Course & Branch**: B.Tech - CE

Regulation: R18 **Year & Sem:** IV-B.Tech & I-Sem

UNIT –I
INTRODUCTION & PRINCIPLES OF ELASTICITY

1	**a**	Define Finite element method in Engineering.	[L1][CO1]	**[02M]**
	b	List out various applications in FEM.	[L1][CO1]	**[02M]**
	c	Define discretization process in FEM.	[L1][CO1]	**[02M]**
	d	List out various types of elements in FEM.	[L1][CO1]	**[02M]**
	e	Write short notes on elasticity and elastic parameters.	[L1][CO1]	**[02M]**
2		Explain the concept of FEM briefly and outline the steps involved in FEM	[L1][CO1]	**[10M]**
3		What are the advantages, disadvantages and applications of FEM	[L1][CO1]	**[10M]**
4		Explain the concept of strain energy and principle of minimum potential energy.	[L2][CO1]	**[10M]**
5		Explain the concept of Rayleigh-Ritz method of functional approximation.	[L2][CO1]	**[10M]**
6		Derive the equation of equilibrium in case of three dimensional stress system.	[L2][CO1]	**[10M]**
7		Derive strain -displacement relationship in matrix form.	[L2][CO1]	**[10M]**
8		Explain the plane stress condition and write the constitutive relations for the plane stress condition.	[L2][CO1]	**[10M]**
9		Explain the plane strain condition and write the constitutive relations for the plane strain condition.	[L2][CO1]	**[10M]**
10		Define Axi-Symmetric Bodies of Revolution with Axi-Symmetric Loading and give expression for strain displacement relation for axi-symmetric bodies.	[L2][CO1]	**[10M]**

Course Code: 18CE0137 **R18**

UNIT –II

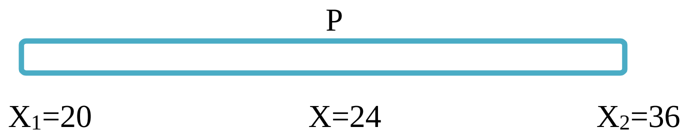
ONE DIMENSIONAL & TWO DIMENSIONAL ELEMENTS

1	**a**	Write the expression for element stiffness matrix of a beam.	[L1][CO2]	**[02M]**
	b	Give the expression for shape functions of a linear element.	[L1][CO2]	**[02M]**
	c	Define plane stress problems with example.	[L1][CO2]	**[02M]**
	d	Define geometric invariance.	[L1][CO2]	**[02M]**
	e	Define plane strain problems with example.	[L1][CO2]	**[02M]**
2		Explain different types of elements in FEM with neat sketch.	[L2][CO2]	**[10M]**
3		Define one-Dimensional element and list out various forces act on a element when load is applied with neat sketch.	[L1][CO2]	**[10M]**
4		Determine the shape functions N_1,N_2,N_3 at interior point 'p' for triangular element with local coordinates P(3,1.5) and global coordinates(1,3),(3,4) and (4,6).	[L2][CO2]	**[10M]**
5		Define shape function and write expression for one dimensional bar element	[L2][CO2]	**[10M]**
6		Explain the Displacement models and generalized coordinates in FEM	[L2][CO2]	**[10M]**
7		Explain various types of coordinate systems in FEM.	[L2][CO2]	**[10M]**
8		Define 2-D elements and explain the I s o Parametric element ,sub -parametric element and superparametric elements in FEM.	[L1][CO2]	**[10M]**
9		Determine the shape functions N_1,N_2,N_3 at interior point 'p' for triangular element with local coordinates P(2,1) and global coordinates(2,3),(3,3) and (3,5).	[L2][CO2]	**[10M]**
10		Explain area coordinate system and volume coordinate system in finite element analysis.	[L2][CO2]	**[10M]**

Course Code: 18CE0137 **R18**

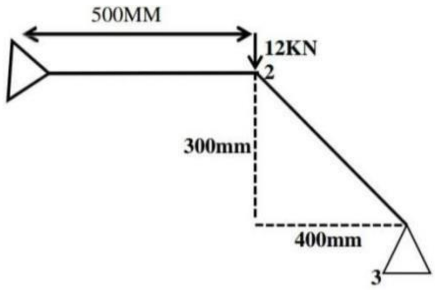
UNIT –III

SHAPE FUNCTIONS

1	**a**	Define shape function.	[L1][CO3]	**[02M]**
	b	Write expression for element stiffness matrix for 2 noded 1-D bar element.	[L1][CO3]	**[02M]**
	c	Write expression for strain displacement matrix for 3 noded 1-D bar element.	[L1][CO3]	**[02M]**
	d	Define Lagrangian element.	[L1][CO3]	**[02M]**
	e	Define serendipity element.	[L1][CO3]	**[02M]**
2		Explain about Convergence & Compatibility requirements in FEM.	[L2][CO3]	**[10M]**
3		Derive the shape functions for 1-D two noded bar element	[L2][CO3]	**[10M]**
4		Derive the shape functions for 1-D three noded bar element.	[L2][CO3]	**[10M]**
5		Differentiate between CST and LST elements.	[L2][CO3]	**[10M]**
6		Define shape function. W rite the properties of shape function and explain with example.	[L2][CO3]	**[10M]**
7		Derive the value of displacement at point p which is shown in fig.Calculate shape functions N_1, N_2 & ε .For above fig. Displacement q_1=0.003 inch and q_2 =0.05inch 	[L2][CO3]	**[10M]**
8		Derive shape function using polynomials by direct method.	[L2][CO3]	**[10M]**
9		Derive shape function using polynomials by matrix method.	[L2][CO3]	**[10M]**
10		Determine the shape functions N_1,N_2,N_3 at interior point 'p' for triangular element.The co-ordinate are P(3.5,5), (2,3),(7,4) and (4,7).	[L2][CO3]	**[10M]**

Course Code: 18CE0137 **R18**

UNIT –IV
BAR AND TRUSSES & PLANE STRESS AND PLANE STRAIN ANALYSIS

1	**a**	Write short notes on generation of stiffness matrix.	[L1][CO4]	**[02M]**
	b	Define bar and truss.	[L1][CO4]	**[02M]**
	c	Write expression for stress-strain relationship matrix for plane stress problems.	[L1][CO4]	**[02M]**
	d	Write expression for stress-strain relationship matrix for plane strain problems.	[L1][CO4]	**[02M]**
	e	Write short notes on CST elements.	[L1][CO4]	**[02M]**
2		Derive the stiffness matrix for stepped bar element.	[L2][CO4]	**[10M]**
3		For two bar truss as shown in figure .Determine the displacement at node 2 and stresses in both elements. E=70Gpa,A=200mm^2 	[L2][CO4]	**[10M]**
4		Derive the shape function for the 3-noded CST element.	[L2][CO4]	**[10M]**
5		Derive the strain displacement matrix for the 3-noded CST element.	[L2][CO4]	**[10M]**
6		Derive the expression for element stiffness matrix for two dimensional elements.	[L2][CO4]	**[10M]**
7		Calculate element stresses σ_x, σ_y, T_{xy}, σ_1, σ_2, and principle angle θp for the CST element . The nodal displacement are u_1=2.0 μm , v_1=1.0 μm , u_2=0.5 μm ,v_2=1.5 μm ,u_3=1.2μm ,v_3=2.8μm . co-ordinates are (10,8) (15,5) , and (18,12). Take E=210 Gpa and poisson's ratio as 0.25. assume plane stress condition.	[L3][CO4]	**[10M]**
8		Evaluate strain displacement matrix and stress -strain matrix for the Tri-angular element under plane stress condition .The co-ordinate are (0,0) (6,0) and (3,5). Assume u=0.25, t=1mm , E=200 Gpa.	[L2][CO4]	**[10M]**
9		Determine the shape function for the rectangular element which has local coordinates ε=0.4 and η=0.2. The Global co-ordinates are (2,2) (3,4) (8,6) and(4,5). Alldimensions are in mm.	[L2][CO4]	**[10M]**
10		For a given triangular element with nodes of coordinates A(2,3) B(5,2) C(3,4).the interior point in a triangle is P(4,5)Calculate shape functions N_1,N_2,&N_3	[L2][CO4]	**[10M]**

Course Code: 18CE0137 **R18**

UNIT –V
ISOPARAMETRIC FORMULATION & AXI-SYMMETRIC ANALYSIS

1	**a**	Define iso-parametric elements.	[L2][CO5]	**[02M]**
	b	Write short notes on lagrangian elements with suitable examples.	[L2][CO5]	**[02M]**
	c	Write short notes on serendipity elements with suitable examples.	[L2][CO5]	**[02M]**
	d	List out various advantages of isoparametric formulation.	[L2][CO5]	**[02M]**
	e	Define Axi-symmetric elements.	[L2][CO6]	**[02M]**
2		Derive the expression for Iso -parametric formulation for CST elements.	[L2][CO5]	**[10M]**
3		Derive the shape function for 4-noded Iso -parametric quadrilateral element.	[L2][CO5]	**[10M]**
4		Derive the shape function for 8-noded Iso -parametric quadrilateral element.	[L2][CO5]	**[10M]**
5		Derive strain displacement matrix and elementary stiffness matrix for 4-noded Iso-Parametric Quadrilateral Elements	[L2][CO5]	**[10M]**
6		Determine the cartesian co-ordinates of the point 'p' which has local coordinates $\varepsilon=0.5$ and $\eta=0.6$. The Global co-ordinates are (2,1) (8,3) (7,7) and (3,5) . All dimensions are in mm.	[L2][CO5]	**[10M]**
7		Determine the shape function N_1,N_2,&N_3 using isoparametric concept at the interior points P (3.85,4.8) for the triangular element. The Global co-ordinates are (1.5,3) (7,3.5) and (4,7) . Alldimensions are in mm.	[L2][CO5]	**[10M]**
8		Determine the Cartesian co-ordinates of the point 'p' which has local co-ordinates $\varepsilon=0.6$ and $\eta=0.3$. The Global co-ordinates are (2,4) (3,6) (8,12) and(4,8). All dimensions are in mm.	[L2][CO5]	**[10M]**
9		Determine the Jacobian matrix for 2-D element which has local co-ordinates $\varepsilon=0$ and $\eta=0$. The Global co-ordinates are (1,1) (5,2) (4,5) and(2,5). All dimensions are in mm.	[L2][CO5]	**[10M]**
10		Explain about formulation of 4-noded Iso-parametric Axi - Symmetric element.	[L2][CO6]	**[10M]**

Prepared by: **Mr D. Sreekanth**
Asst. Prof
CE