SWARNANDHRA COLLEGE OF ENGINEERING AND TECHNOLOGY
(Autonomous)
Narsapur, West Godavari District, A.P. 534280
DEPARTMENT OF MECHANICAL ENGINEERING

TEACHING PLAN

	Course Title	Semester	Branches	Contact Periods /Week	Academic Year	Date of commencement of Semester
23ME6T03	FINITE ELEMENT METHODS (R23)	VI	Mechanical Engineering & Robotics	6	2025-26	10-12-2025

COURSE OUTCOMES

1	Describe stress-strain relations, equilibrium, and basic FEM concepts [K2]
2	Apply variational and weighted residual techniques in FEM formulation [K3]
3	Formulate and solve 1D bar and truss problems using FEM [K3]
4	Analyze and Solve beam problems. [K4]
5	Analyze beam and 2D structural elements using FEM [K4]
6	Evaluate thermal and dynamic systems using finite element methods [K4]

UNIT	Out Comes / Bloom's Level	Topics No.	Topics/Activity	Text Book / Reference	Contact Hour	Delivery Method
I	Describe stress-strain relations, equilibrium, and basic FEM concepts [K2] Apply variational and weighted residual techniques in FEM formulation [K3]		**Unit-1 Introduction**			
		1.1	Introduction to FEM, applications, advantages & limitations	T1, R1	1	Chalk and talk /ppt/ /quiz/ PBL/ Videos/ Animation
		1.2	Stress and equilibrium equations	T1, R1	1	
		1.3	Strain–displacement relations	T1, R1	1	
		1.4	Stress–strain relations	T1, R1	1	
		1.5	Plane stress and plane strain conditions	T1, R1	2	
		1.6	Variational methods (principle of minimum potential energy.)	T1, R1	2	
		1.7	Weighted residual methods (Galerkin method)	T1, R1	2	
		1.8	One-dimensional problems (simple bar problems)	T1, R1	2	
Content beyond Syllabus			Introduction to functional approximation and interpolation errors		1	
				Total	**13**	
II	Formulate and solve 1D bar and truss problems using FEM [K3]		**Unit-2. Bar element formulation**			
		2.1	Discretization of domain, element shapes	T1	1	Chalk and talk /ppt/ /quiz/ Videos/ Animation
		2.2	Discretization procedures, mesh generation	T1	1	
		2.3	Interpolation (shape) functions	T1	2	
		2.4	Local and global coordinates	T1	1	
		2.5	Derivation of bar element stiffness matrix	T1	1	
		2.6	Assembly of global stiffness matrix	T1	1	
		2.7	Band width, node numbering techniques	T1	1	
		2.8	Boundary conditions and convergence requirements	T1	1	

		2.9	FEM modeling of trusses	T1	1	
		2.10	Coordinates, shape functions for truss elements	T1	1	
		2.11	Assembly of global stiffness matrix & load vector	T1	1	
		2.12	Boundary conditions, stress & strain calculation	T1	1	
		2.13	Support reactions & numerical problems	T1	2	
CON			Determination Stress and deformation by using ANSYS		1	
				Total	**16**	
III	Analyze and Solve beam problems. [K4]	**Unit-3. Analysis of Beams:**				
		3.1	Introduction to beam elements	R1,T1	1	Chalk and talk /ppt/ /quiz/ PBL/ Videos/ Animation
		3.2	Hermite beam shape functions	T1, T2	2	
		3.3	Derivation of beam element stiffness matrix	T1, T2	3	
		3.4	Load vector derivation (point load & UDL)	T1, T2	2	
		3.5	Numerical problems on beams	T1, T2	3	
Content beyond Syllabus			Analysis of beams in ANSYS SOFTWARE		1	
				Total	**12**	
IV	Analyze beam and 2D structural elements using FEM [K4]	**Unit-4. Two-dimensional stress analysis**				
		4.1	Plane stress & plane strain FEM modeling	T1, T2	1	Chalk and talk /ppt/ /quiz/ Videos/ Animation/flipped class
		4.2	Constant Strain Triangle (CST) element formulation	T1, T2	3	
		4.3	Assembly and boundary conditions in 2D	T1, T2	2	
		4.4	Axisymmetric problems formulation	T1, T2	2	
		4.5	Numerical Problems	T1, T2	1	
		4.6	One-dimensional quadratic & cubic elements	T1, T2	2	
		4.7	Natural coordinates & shape functions	T1, T2	1	
		4.8	2D four-node isoparametric elements	T1, T2	1	
		4.9	Numerical integration (Gauss quadrature)	T1,T2	1	
CON			Analysis of 2D Stress in ANSYS SOFTWARE		1	
				Total	**15**	
V	Evaluate thermal and dynamic systems using finite element methods [K4]	**Unit 5.Thermal analysis and Dynamic Analysis:**				
		5.1	Introduction to heat transfer FEM	T1, R1	1	Chalk and talk /ppt/ /quiz/ PBL/ Videos/ Animation
		5.2	1D heat conduction equation	T1, R1	2	
		5.3	FEM formulation of a fin	T1, R1	1	
		5.4	Numerical problems on fins	T1, R1	1	
		5.5	Introduction to dynamic FEM	T1, R1	1	
		5.6	Element mass matrices (lumped & consistent)	T1, R1	1	
		5.7	Formulation of equations of motion	T1, R1	1	
		5.8	Eigenvalues & eigenvectors	T1, R1	1	
		5.9	Free vibration analysis problems	T1, R1	1	
CON			Dynamic Analysis in ANSYS SOFTWARE		1	
				Total	**11**	
				CUMULATIVE PROPOSED PERIODS	**67**	

Text Books:	
S.No.	AUTHORS, BOOK TITLE, EDITION, PUBLISHER, YEAR OF PUBLICATION
1	Chandrubatla & Belagondu, Finite element methods , fifth edition ,TMH,2022
2	S.S. Rao ,The Finite Element Method in Engineering, Fifth Edition 2020
Reference Books:	
S.No.	AUTHORS, BOOK TITLE, EDITION, PUBLISHER, YEAR OF PUBLICATION
1	.J.N. Reddy, Finite element method in Heat transfer and fluid dynamics, CRC press, 2021
2	Zienckiwicz O.C. Finite Element Method, McGraw-Hill,Third Edition, 2010
Web Details	
1	https://www.accessengineeringlibrary.com/browse/introduction-to-the-finite-element-method-fourth-edition
2	https://link.springer.com/book/10.1007/978-981-19-7989-7
3	https://www.amazon.in/finite-element-methods/s?k=finite+element+methods

		Name	Signature with Date
i.	Faculty	Dr A Gopichand	
ii.	Course Coordinator	Mr Ch Harish Kumar	
iii.	Module Coordinator	Mr B Mahesh Krishna	
iv.	Programme Coordinator	Dr Francis Luther King M	

Principal