GANPAT UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

Programme	Master of Technology	Branch	Mechanical Engineering (Specialization in Additive Manufacturing)
Semester	II	Version	1.0.0.0
Effective from Academic Year	**2025-26**	Effective for the batch Admitted in	**July 2025**
Subject code	**3ME2115**	Subject Name	**Finite Element Method**

Teaching scheme						Examination scheme (Marks)			
(Per week)	Lecture(DT)		Practical(Lab.)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	3	0	2	0	5	Theory	40	60	100
Hours	3	0	4	0	7	Practical	60	40	100

Pre-requisites:

Students should be compatible to basics of computer systems operating, basics of engineering drawing and drafting, to perform AutoCAD two dimensional drawings, formal knowledge of limit, fit, tolerances and surface finish symbols.

Course Learning Outcomes:

The course content should be taught and implemented with an aim to develop different skills leading to the achievement of the following competencies and course learning outcomes:

CO1. Explain the theoretical foundations, assumptions, and procedural steps involved in the Finite Element Method.

CO2. Formulate and assemble element stiffness matrices for one-dimensional structural elements such as bars, trusses, beams, and frames.

CO3. Analyze two-dimensional continuum problems including plane stress, plane strain, and axi-symmetric conditions using FEM.

CO4. Apply FEM concepts to formulate and solve heat transfer and introductory coupled-field engineering problems.

CO5. Utilize commercial FEM software tools to simulate and interpret Additive Manufacturing–related structural and thermal problems.

Course Content

Name of UNIT	Unit Content	Hrs
UNIT – I: Introduction to Finite Element Method	Need for FEM in engineering analysis, historical development of FEM, basic terminology and concepts, discretization of continua, general steps involved in FEM, scope and applications of FEM in mechanical and additive manufacturing engineering.	**5**
UNIT – II: Approximation and Mathematical Modeling	Review of elasticity and continuum mechanics, mathematical models for structural problems, equilibrium equations in differential form, energy approach and integral formulations, principle of virtual work and variational formulation, overview of approximate solution techniques including Ritz, Rayleigh–Ritz, and Galerkin methods, relevance of shape functions and interpolation.	**10**

UNIT – III: Finite Element Method for One-Dimensional Problems	Formulation of FEM for one-dimensional structural problems, bar and truss elements, derivation of element stiffness matrices and load vectors, consistent and lumped load vectors, treatment of boundary conditions using elimination and penalty methods, higher-order elements and convergence aspects, formulation of beam elements, bending of beams, plane and space frame analysis, introduction to contact problems with illustrative case studies.	**15**
UNIT – IV: Finite Element Method for Two-Dimensional Problems	Interpolation in two dimensions, natural coordinate systems, isoparametric representation, Jacobian transformation, finite element formulation for plane stress, plane strain, and axi-symmetric problems, triangular and quadrilateral elements, higher-order elements, subparametric, isoparametric, and superparametric elements, general considerations in 2D FEM analysis, introduction to plate bending and shell elements.	**15**

List of Practical

The practical should be carried out in such a manner that students are able to acquire different learning out comes in cognitive, psychomotor and affective domain to demonstrate course learning outcomes.

No.	Unit	Name of Practical
1	1	To prepare 3D solid parts using AutoCAD command including Extrude, Revolve, Sweep and Loft.
2	3	Measure the von-misses stress using Ansys software
3	5	Ansys for solving engineering problem

List of Instruments / Equipment / Trainer Board	
1	CAD Workstations.
2	3D printer based on any AM technique
3	Ansys Software (student version)
4	Latest educational network version of solid works Creo, Unigraphics, CATIA, Solid Edge, Inventor, software (Any one).

List of Reference Books

No.	Title of Reference Books	Authors	Publication
1	Textbook of Finite Element Analysis	Seshu P	PHI
2	Finite Element Method in Engineering	Reddy, J.N	Tata McGraw Hill
3	Finite element Method in Engineering	Singiresu S.Rao	Elsevier