

# GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Semester: 2

**Mechanical Engineering (CAD/CAM)**

Subject Name Finite Element Method

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Sr.No	Course content
1.	Introduction to FEM: basic concepts, historical back ground, application of FEM, general description, comparison of FEM with other methods, Variational approach, Galerkin's Methods.
2.	Co-ordinates, basic element shapes, interpolation function. Virtual energy principle, Rayleigh- Ritz method, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, strain displacement relations
3.	1-D structural problems – axial bar element – stiffness matrix, load vector, temperature effects, Quadratic shape function. Analysis of Trusses – Plane Truss and Space Truss elements
4	Analysis of beams – Hermite shape functions – stiffness matrix – Load vector – Problems 2-D problems –CST, LST, force terms, Stiffness matrix and load vector, boundary conditions.
5	Isoparametric element – quadrilateral element, Shape functions – Numerical Integration – sub parametric and super parametric elements. 3-D problems – Tetrahedral element – Jacobian matrix – Stiffness matrix.
6	Dynamic considerations, Dynamic equations – consistent mass matrix – Eigen Values, Eigen Vector, natural frequencies – mode shapes – modal analysis
7	Applications of numerical procedures to determine natural frequencies and mode shapes. Finite Element Method for dynamic analysis
8	Scalar field problems - 1-D Heat conduction – 1-D fin element – 2-D heat conduction problems – Introduction to Torsional problems
9	Introduction to Non linearity, Non linear problems; Geometric Non-linearity, Material Non-linearity, Non linear dynamic problems, analytical problems

## **Tutorials:**

Tutorials should be given based on the below mentioned topics :

1. 1D & 2D structural analysis.
2. 1D and 2D heat transfer problems.
3. Analysis of plane trusses.
4. Computation of shape function.
5. Computer programmes for 3D structural analysis.
6. Formulation and solution of dynamic problems using computer programmes.

## REFERENCE BOOKS:-

1. Introduction to finite elements in engineering by Tirupathi K. Chandrupatla and Ashok D.Belegundu.
2. CAD / Cam and Automation by Farazdak Haidery, Nirali Prakashan.
3. Practical Finite Element Analysis by Nitin S. Gokhale, Sanjay S.Deshpande, Sanjeev V. Bedekar and Anand N. Thite, Finite to infinite, Pune.
4. Finite Element Procedures in Engineering analysis by K.J Bathe.
5. An Introduction to Nonlinear Finite Element Analysis by J.N.Reddy, Oxford University Press.
6. The finite element methods in Engineering – S.S. Rao - Pergamon, New York.
7. An Introduction to Finite Element Methods – J. N. Reddy – Mc Graw Hill.
8. A Textbook of Finite Element Analysis by P. Seshu
9. The Finite Element Method in Engineering science – O.C. Zienkiewicz, Mc Graw Hill. Concepts and applications of finite element analysis – Robert Cook