I Year M.Tech. Machine Design, I Semester	L	T	P	TO	C
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(ME 507) ADVANCED FINITE ELEMENT ANALYSIS

Objective of the Course :

This course presents the theory and application of the finite element method for analyzing structural systems and also heat transfer problems. Approximation theory for structural problems is presented as the basis for finite element methods.

UNIT – I

Introduction to FEM: Role of finite element analysis in design, comparison of fem with other methods.

Procedures for finite element analysis. Potential 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.

UNIT – II

One-dimensional elements – Analysis of Bars and Trusses Axial bar element, stiffness matrix, load vector and quadratic shape functions. Plane trusses the element stiffness matrix stress calculations, temperature effects.

Beam Elements : Analysis of Beams one dimensional beam element, two dimensional beam element finite element formulation, stiffness matrix and force vector.

UNIT – III

Isoparametric element - quadrilateral element, Shape functions - Numerical Integration.

3-D problems - Tetrahedran element - Jacobian matrix - Stiffness matrix.

UNIT – IV

Introduction to the use of FEM in steady state field problems one dimensional heat conduction - conductivity matrix and Heat Rate vector. One-dimensional Heat Transfer in thin fins. Boundary conditions convection matrix heat rate vector.

UNIT – V

Dynamic considerations : Formulation for point mass and distributed masses, element mass matrix of one dimensional Bar element. Eigen vectors, Applications to Bars, Stepped Bars and Beams. Natural Frequencies, mode shapes.

TEXT BOOKS:

1. Chandraputla, Ashok and Belegundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice – Hall, 2007.
2. SS Rao, "The Finite Element Methods in Engineering", 4th Edition, Elsevier Publishers, 2010.

REFERENCE BOOKS:

1. C.S. Krishna Murthy, "Finite Element Analysis", 2nd Edition, TMH Publishers, 2009.
2. JN Reddy, "An Introduction to Finite Element Method", 1st Edition, Oxford University Press, 2009.
3. Kenneth H. Huebner, Donald L. Dewhirst, Douglas E. Smith and Ted G. Byron, "The Finite Element Method for Engineers", 4th Edition, John Wiley Publishers, 2009.