Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NGPD507	**Finite Element Analysis**	3	0	0	3

Course Objective
The primary objective of the course is make the student learn to tie his/her understanding of engineering design concepts to use the Finite Element Methods correctly and efficiently.
Learning Outcomes
Upon successful completion of this course, students will be able to • understand the numerical methods involved in Finite Element Theory • understand the role and significance of shape functions in finite element formulations and use them for interpolation. • understand direct and formal (basic energy and weighted residual) methods for deriving finite element equations • understand global, local, and natural coordinates and the formulation of multi-dimensional elements

Unit No.	**Topics to be Covered**	Lecture Hours	**Learning Outcome**
1	Introduction to Energy Methods, Principle of Virtual Work, Principle of Minimum Potential Energy,	3	Learning basic analytical methods
2	Rayleigh Ritz Method, Hamilton's Principle.	3	Understanding important theorems
3	Introduction to Variational Methods, Weak form of Governing Equation, Weighted residual method.	4	Learning methods to formulate equations
4	Introduction to Finite elements for Deformation Analysis. Discretisation of a Continuum, Element shapes, nodes, nodal unknowns and coordinate systems, meshing. Shape functions.	4	Learning Basics of finite element approach
5	Galerkin Finite elements, Virtual work method.	4	Further details of finite element method

6	Basic equation of hydrodynamics and heat transfer. Diffusion Matrix; Finite element analysis of heat transfer and incompressible fluid flow.	4	Application of Finite element to fluid flow problems
7.	Discretisation of structures, Formulation of Stiffness Matrix. Finite element methods for structural dynamics and wave propagation.	4	Application of Finite element to structural problems
8.	Basic equation of elasticity: equation of equilibrium, strain displacement equation. Lagrange Polynomials, Hermite Polynomials, Strain displacement Matrix. Finite element analysis of plane stress and plane strain problem.	4	Application of Finite element to elasticity problems
9.	Isoparametric formulation, Mass and damping matrix formulation.	4	Advanced finite element formulation
10.	Direct time integration, Implicit and Explicit Methods	4	Solving time dependent equations
11.	Spectral finite elements. p-type, h-type and hptype finite elements.	4	Knowing other types of finite element methods
	Total	42	

Text books

1. O. C. Zienkiewicz and K. Morgan, Finite Elements and Approximation, Dover, 2006
2. K.J. Bathe, Finite element procedures, PHI Ltd., 1996.

Reference books

1. Jean Donea and Antonio Huerta, Finite Element Methods for Flow Problems, John Wiley and Sons, 2003
2. O.C. Zienkiewicz and R.L. Taylor, Finite element methods Vol I & Vol II, McGraw Hill, 1989, 1992.
3. R.D. Cook, D.S. Malkus. and M.E. Plesha, Concepts and applications of finite element analysis, John Wiley and Sons, 1989.