Course Code	Course Title	L	T	P	C
20SE003	NUMERICAL METHODS IN CIVIL ENGINEERING	3	0	0	3

PRE-REQUISTE COURSES: Mathematics

COURSE OBJECTIVES:

This Course aims to impart knowledge about various methods of analysing linear equations numerically and to familiarize students in the field of Interpolation to expose the students to calculus of Numerical integration and differentiation techniques. Students Can able to understand partial differential equations in the field of Civil Engineering to solve boundary value problems associated with engineering applications and can expose to the concept of linear programming optimization techniques.

COURSE OUTCOMES:

At the end of the course student will be able to

CO's	Course Outcomes	PO's
1	To apply Eigen value problems in finding natural time period and mode shapes of structures.	1,2
2	To apply interpolation and differentiation formulas for calculating deflection of beams, analysis of columns and simply supported beams.	2
3	To apply numerical integration and differentiation techniques in calculation of slopes and deflections of beams.	3,5
4	To analyze one dimensional heat flow equations using partial differential equations.	4,5
5	To learn linear optimization techniques	1,2

SKILLS:

- ✓ Ability to develop Eigen values and vectors for finite element analysis
- ✓ Develop the caliber to generate mathematical equations for elasticity problems
- ✓ Optimization of structures by forming Linear Programing Techniques
- ✓ Analysis of heat transformation using partial differential equation

UNIT-I:

SOLUTIONS OF LINEAR AND NONLINEAR ALGEBRAIC EQUATIONS:, Direct method – Cramer's rule, Guass – Elimination method - Gauss – Jordan elimination – Triangulation (LU Decomposition) method – Iterative methods Jacobi – Iteration method – Gauss – Siedel iteration, Eigen values and Eigen vectors: Jacobi method for symmetric matrices- Given's method for symmetric Matrices-Householder's method for symmetric Matrices-Power Method. Nonlinear Methods- Newton-Raphson Method, Regula Falsi Method, Secant Method

UNIT –II:

INTERPOLATION: polynomials using finites differences, differentiation formulas by Interpolating parabolas – Backward, Forward and Central differences- Derivation of differentiation formulas using Taylor series, Boundary conditions- Beam Deflection Numerical solution to spatial differential equations – Application to Simply Supported Beams, Columns.

UNIT-III:

NUMERICAL INTEGRATION AND DIFFERENTIATION: Method based on interpolation-method based on undetermined coefficient – Gauss – Lagrange interpolation method– Double integration using Trapezoidal and Simpson's method New Marks Method and Application to Beams – Calculations of Slopes & Deflections, Applications of Finite Difference Methods for Structural Elements

UNIT-IV:

APPLIED PARTIAL DIFFERENTIAL EQUATIONS: One-dimensional Heat equation Cartesian, cylindrical and spherical coordinates (problems having axi-symmetry). Two-dimensional Laplace Equation in Cartesian, cylindrical and spherical coordinates (problems having axi-symmetry) – Analytical solution by separation of variables technique.

UNIT-V:

LINEAR AND NONLINEAR PROGRAMMING TECHNIQUES: Linear Programming Problem Formation, Graphical Method, Simplex method, artificial variable Method-Big-M Method-Two Phase Method. Non Linear Programming Problem Gradient method, Steepest Ascent Descent Methods

TEXT BOOKS:

1. Jain M.K, Iyengar S.R.K "Numerical Methods for Scientific and Engineering Computations". R.K.Jain Willey Eastern Limited. New Age International (p) Ltd., Publishers, 2004
2. Duffy, D.G. "Solutions of Partial Differential Equations", CBS Publishers, 1988

REFERENCES:

1. Shanta Kumar M, "Computer based numerical analysis", Khanna Book publishers New Delhi.
2. Sankara Rao K., "Introduction to Partial Differential Equations", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.