ADVANCED COMPUTATIONAL METHODS

Course Code: 13BM2101

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Pre-requisites: Fundamental concepts of calculus, ordinary differential equations, and elementary numerical methods

Course Educational Objectives:

To make the student understand

1. non-iterative and iterative methods to solve systems of linear equations
2. Eigen values and Eigen vectors
3. various methods of numerical differentiation and integration
4. methods of solution of certain types of partial differential equations

Course Outcomes:

The student will be able to

1. use advanced numerical methods in modern scientific computing.
2. use numerical methods to interpolate functions and their derivatives.
3. solve ordinary and partial differential equations using numerical methods.
4. to formulate mathematical models for engineering problems to choose appropriate methods to solve them

UNIT-I

System of linear equations: Gauss elimination method, triangularization method, Cholesky method, Partition method, Error Analysis for Direct Methods.

Iteration Methods: Jacobi Iteration Method, Gauss Seidel Iteration Method, SOR Method.

UNIT-II

Eigen value and Eigen Vectors, Bounds on Eigen values, Jacobi Method for symmetric matrices, givens method for symmetric matrices, householders method, power method.

UNIT-III

Numerical differentiation: Introduction, methods based on undetermined coefficients, optimum choice of step length, extrapolation methods, partial differentiation.

Numerical Integration: Introduction, open type integration rules, methods based on undetermined coefficients: Gauss-Legendre, Gauss-Chebyshev, Romberg Integration.

Double integration: Trapezoidal method, Simpson's method.

UNIT-IV

Numerical Solutions of ordinary differential equations (boundary value problem): introduction, shooting method: linear and non linear second order differential equations.

UNIT-V

Numerical solutions of partial differential equations: introduction, finite difference approximation to derivatives. Laplace equation- Jacobi method, Gauss Seidel Iteration Method, SOR Method, Parabolic Equations, iterative methods for parabolic equations, hyperbolic equations.

TEXT BOOKS:

1. M.K. Jain, S.R.K. Iyengar and R.K.Jain, "*Numerical Methods for Scientific and Engineering Computation*", New Age International (P) Limited, Publishers, 4th Edition, 2003.

2. S.S.Sastry, "*Introductory Methods of Numerical Analysis*", Prentice Hall India Pvt., Limited, 4th Edition.

REFERENCES:

1. Samuel Daniel Conte, Carl W. De Boor**, "***Elementary Numerical Analysis: An Algorithmic Approach***",** 3rd Edition**,** McGraw-Hill.