III Year I Semester	L	T	P	C
Code:20EC5316	3	0	0	3

SCIENTIFIC COMPUTING

Course Objectives:

1. To know the fundamentals of computing methods.
2. To study various linear computing methods.
3. To discuss computing based on Eigen Values and SVD.
4. To study various Non-linear computing methods.
5. To study Numerical Differentiation and Integration methods.

Unit-I: Introduction

Sources of Approximations, Data Error and Computational, Truncation Error and Rounding Error, Absolute Error and Relative Error, Sensitivity and Conditioning, Backward Error Analysis, Stability and Accuracy.

Computer Arithmetic

Floating Point Numbers, Normalization, Properties of Floating Point System, Rounding, Machine Precision, Subnormal and Gradual Underflow, Exceptional Values, Floating-Point Arithmetic, Cancellation.

Unit-II: System of liner equations

Linear Systems, Solving Linear Systems, Gaussian elimination, Pivoting, Gauss-Jordan, Norms and Condition Numbers, Symmetric Positive Definite Systems and Indefinite System, Iterative Methods for Linear Systems.

Linear least squares

Data Fitting, Linear Least Squares, Normal Equations Method, Orthogonalization Methods, QR factorization, Gram-Schmidt Orthogonalization, Rank Deficiency, and Column Pivoting.

Unit-III: Eigen values and Singular values

Eigen values and Eigenvectors, Methods for Computing All Eigen values, Jacobi Method, Methods for Computing Selected Eigen values, Singular Values Decomposition, Application of SVD.

Unit-IV: Nonlinear equations

Fixed Point Iteration, Newton‟s Method, Inverse Interpolation Method Optimization:One-Dimensional Optimization, Multidimensional Unconstrained Optimization, Nonlinear Least Squares.

Interpolation

Purpose for Interpolation, Choice of Interpolating, Function, Polynomial Interpolation, Piecewise Polynomial Interpolation.

Unit-V: Numerical Integration and Differentiation

Quadrature Rule, Newton-Cotes Rule, Gaussian Quadrature Rule, Finite Difference Approximation, Initial Value Problems for ODES, Euler‟s Method, Taylor Series Method, Runga-Kutta Method, Extrapolation Methods, Boundary Value Problems For ODES, Finite Difference Methods, Finite Element Method, Eigen value Problems Partial Differential

Equations, Time Dependent Problems, Time Independent Problems, Solution for Sparse Linear Systems, Iterative Methods, Fast Fourier Transform, FFT Algorithm, Limitations, DFT, Fast polynomial Multiplication, Wavelets, Random Numbers and Simulation, Stochastic Simulation, Random Number Generators, Quasi-Random Sequences.

Course Outcomes:

A student who successfully fulfils this course requirement will be able to:

S. No	Course Outcome	BTL
1.	Understand the significance of computing methods.	L2
2.	Perform the computations using linear equations.	L3
3.	Perform the computations using Eigen values and SVD.	L3
4.	Perform the computations using non- linear equations.	L3
5.	Perform the computations using Numerical Differentiation and Integration.	L3

Correlation of COs with POs & PSOs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	-	-	-	-	-	-	-	-	-	-	2	-
CO 2	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO 3	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO 5	3	2	2	-	-	-	-	-	-	-	-	-	2	-

Text Books:

1. Heath Michael T., "Scientific Computing: An Introductory Survey", McGraw- Hill, 2nd Ed., 2002.
2. Press William H., Saul A. Teukolsky, Vetterling William T and Brian P. Flannery, "Numerical Recipes: The Art of Scientific Computing", Cambridge University Press, 3rd Ed., 2007.
3. Xin-she Yang (Ed.)., "Introduction To Computational Mathematics", World Scientific Publishing Co., 2nd Ed., 2008.

Reference Books:

1. Kiryanov D. and Kiryanova E., "Computational Science", Infinity Science Press, 1st Ed., 2006.
2. Quarteroni, Alfio, Saleri, Fausto, Gervasio and Paola, "Scientific Computing With MATLAB And Octave", Springer, 3rd Ed., 2010.