

Approval 10th senate meeting

Course Name : Computational Methods for Physicists
Course Number : PH 621
Credits : 2-0-4-4
Prerequisites : Faculty consent
Intended for : I-Ph.D., M.Sc., B.Tech 3rd and 4th Year.
Distribution : Core for I-Ph.D. ; Elective for the rest
Semester : Odd/Even

Preamble : The objective of the proposed course is to introduce students to the basic ideas of numerical methods and programming

Course Outline : The course will cover the basic ideas of various numerical techniques for interpolation, extrapolation, integration, differentiation, solving differential equations, matrices and algebraic equations

Modules :

- *Basic introduction to operating system fundamentals*
(4 lectures)

- Introduction to C: Program Organization and Control Structures loops, arrays, and function, Error, Accuracy, and Stability.
(8 lectures)

- Interpolation and Extrapolation - Curve Fitting: Polynomial Interpolation and Extrapolation Cubic Spline Interpolation Fitting Data to a Straight Line, examples from experimental data fitting
(8 lectures)

- Integration and differentiation: Numerical Derivatives Romberg Integration Gaussian Quadratures and Orthogonal Polynomials,
(8 lectures)

- Root Finding: Newton-Raphson Method Using Derivative - Roots of a Polynomial
(8 lectures)

- Ordinary Differential Equations: Runge-Kutta Method, Adaptive Stepsize Control for Runge-Kutta, Examples from electrodynamics and quantum mechanics (8 lectures)

- Matrices and algebraic equations: Gauss-Jordan Elimination Gaussian Elimination with Backsubstitution, LU Decomposition
(8 lectures)

- Concept of simulation, random number generator
(2 lectures)

Textbooks:

1. The C Programming Language by B W Kernighan and D M Richie (PHI Learning Pvt. Ltd, 2011)
2. Elementary numerical analysis : algorithmic approach by S D Conte and C de Boor (McGraw-Hill International, 1980)

References:

1. Computer Programming in C by V. Rajaraman, (PHI Learning Pvt. Ltd, 2011).
2. Numerical Methods by Germund Dalquist and Ake Bjork (Dover Publications ,1974)
3. Numerical Recipes by William H. Press, Saul A. Teukolsky, William T. Vetterling, and Brian P. Flannery, (Cambridge University Press, 1992).