PPH109 COMPUTATIONAL METHODS IN PHYSICS

L	T	P	Cr
3	0	0	0

Course Objectives: To learn computer programming using FORTRAN 90, solve physics problems through different numerical techniques and use computer programming for simulation and data analysis

Introduction: Role of computers in physics; Numerical analysis, modeling and simulation; Flow charts; Introduction to computer programming in Fortran 90**,** Integer and Floating point arithmetic**,** Operators and Expressions, While, Do-While, For loops, Arrays and Strings, Functions, I/O with files**.**

Root Finding Methods: Methods for determination of zeroes of linear and nonlinear algebraic and transcendental equations: Secant Method, False Position, Newton-Raphson Method; Convergence of solutions; Solution of simultaneous linear equations, Gauss Elimination, pivoting, iterative method

Interpolation and Approximation: Introduction to interpolation, Lagrange approximation, Newton polynomials, Curve fitting by least squares, Polynomial least squares and cubic splines fitting.

Numerical Differentiation and Integration: Numerical differentiation, Quadrature, Simpson's rule, Gauss's quadrature formula, Newton – Cotes formula.

Random Variables and Monte Carlo Methods: Random numbers, Pseudo-random numbers, Monte Carlo integration: Moment of inertia, Monte Carlo Simulations: Buffen's needle experiment, Importance of sampling, Random Walk

Differential Equations: Euler's method, Runge Kutta methods, Finite difference method, Finite difference equations for partial differential equations and their solution.

Course Outcomes: Students will be able to

1. write computer programs using FORTRAN 90
2. use different numerical methods to solve problems using computer programs.
3. simulate physical systems using Monte Carlo Method.

Recommended Books:

1. *Mathews, J.H., Numerical Methods for Mathematics, Science and Engineering, Prentice-Hall, (2000).*
2. *Rajaraman, V., Computer programming in Fortran 90 and 95, Prentice-Hall of India, (2008).*
3. *Salaria, R.S., Programming in Fortran, Khanna Publishing, (2008).*
4. *William H. Press, , Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery, Numerical Recipes: The Art of Scientific Computing, Cambridge University Press, (2007)*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	45
3	Sessionals (May include assignments/quizzes)	25