

# A Course on Scientific Programming (Using FORTRAN)

**Course Code:** PAS6112  
**Course Credits:** 02

**Course Type:** Inter Disciplinary Course  
**Target Students:** UG (3<sup>rd</sup> Semester)

## Course Objectives:

- Understanding the fundamentals of computer programming and apply the ideas of numerical methods for solving scientific problems.

**Learning Outcomes:** After the completion of the course the student will be able to:

- Understand basics of computer programming
- Model basic problems of physics
- Solve the physics problems numerically

## Course Contents

### Unit 1: Basics of input, output and control instructions in FORTRAN (05 Hours)

Basics of computer programming, INPUT and OUTPUT instructions, FORMAT statement. FORTRAN CONSTANTS, VARIABLES and EXPRESSIONS. Control statements, IF condition, GOTO, DO loop. ARRAYS and their processing in FORTRAN. FILE processing.

### Unit 2 Numerical integration (05 Hours)

Integral as area under the curve, *trapezoidal rule*, Newton–Cotes formula: Simpson rules. Random numbers and stochastic methods to solve integral. Monte-Carlo approach to solve 1D integrals. Implementation of all methods using FORTRAN.

### Unit 3 Numerical differentiation (05 Hours)

Basic definition of derivative, discretization, step size and finite difference formulae for obtaining derivatives. Taylor series. Forward difference, backward difference and central difference formula for obtaining first order derivatives. Second order derivatives. Errors in numerical derivatives.

### Unit 4 Numerical solution of differential equations (05)

Basic introduction to differential equations, ordinary differential equations of first and second order. Euler method and error analysis. Overview and application of Newton–Raphson methods. Runge–Kutta methods.

## Prescribed Textbooks:

1. *Numerical methods* by E. Balagurusamy, Tata McGraw Hills
2. *Computer Programming in FORTRAN-77* by V. Rajaraman, Prentice Hall India

## Other Resources/Reference books:

1. *Computational Physics* by Nicholas J. Giordano, Prentice Hall India
2. *A first course in computational physics* by Paul L. DeVries John Wiley and Sons