ADD-ON COURSE
OFFERED BY THE DEPARTMENT OF PHYSICS
BIJNI COLLEGE::BIJNI

Course Title	: Numerical Methods and their Implementations in Physics Using C++ Programming Language
Course Code	: NMIPCPL-101
Course Duration	: 30 Hours
Credit	: 2(1 Credit = 15 Hrs.)
Course Designed by	: Sanjita Ray, HoD & Assistant Professor
	: H.J. Hussain, Assistant Professor
	: Mrs. Jayshri Narzary, Assistant Professor
Course Co-ordinator	: Mrs. Jayshri Narzary, Assistant Professor
Approved by	: Governing Body,Bijni College, Bijni
Date of Approval	: 14-02-2025

Course Description:

The course is designed to tech the students about the theory and application of Numerical Methods in Physics Using C++ Programming Language. It is a course related sort term add-on course. Numerical methods are essential tools in physics for solving mathematical problems that are difficult or impossible to solve analytically. These methods approximate solutions to equations, integrals, and differential equations, enabling physicists to model complex systems. C++ is a popular programming language for implementing numerical methods due to its speed, efficiency, and extensive library support.

Course Objectives:

➢ To equip the students with the C++ Programming Language.

➢ To solve the various problems related to Physics UG course with the help of the programming Language.

Course Outcomes:

This ADD-ON Course enabled students to be skilled with computer Programming like C++ program. They also got confidence in handling the mathematical problems related to Physics syllabus and to find the solutions. Basically, this program made the students free with the computer with the hands-on practice. At the end of the program of 30 hours all the 39 students became confident and skilled in Programming Language.

Course Structure:

Unit-1: Introduction (10 Hours)

Introduction and Overview (Computer architecture and organization, memory and Input/output devices) Basics of scientific computing, errors and error analysis (Truncation and round off errors, Absolute and relative errors, Floating point computations) Difference between folk, Ayurvedic, and modern medicine

Unit-2: C++ Programming fundamentals

Introduction to programming, constants, Variables and data types, operators and expressions, I/O statements, scan and print, cin and cout, control loops and control statements.

Unit-3: Application (10 Hours)

Basic C++ programs and their implementation in physics problems (Estimating the value of pi (π), solution of algebraic equations by Bisection Method, Regula Falsi Method, Newton Raphson Method, interpolation by Newton Gregory Forward and Backward difference formula, solving numerical differentiation and integration by Trapeziodal and Simpsons 1/3rd Rule, solving ODE by Euler and Runge-Kutta (RK) second and fourth order methods, etc.).

Unit-4: Programming (5 Hours)

C++ programming for Least Square fitting, Diagonalization of matrices, Inverse of a matrix, Eigen vectors, Eigen values problems, etc.

Unit-5: Implementation (5 Hours)

C++ programming implementation for various problems of Quantum Mechanics and Statistical Mechanics

Suggested Readings:

a. Shah, Nita H. (2008). *Numerical Methods with C++ Programming,* Kindle Edition, PHI Learning,

b. Beu, Titus A. Beu (2014*). Introduction to Numerical Programming: A Practical Guide for Scientists and Engineers Using Python and C/C++ (Series in Computational Physics)* Paperback

c. Alejandro. Garcia, *Numerical Methods for Physics,* Pearson Education (US)

d. Hardcover, Python (2020), *Numerical Methods in Physics,* Cambridge University Press

Evaluation Process

1. A minimum of 75% class attendance is mandatory for course completion.5 marks will be assigned for attendance. 1 mark for 75%-80% attendance,2 marks for 81%-85% attendance, 3 marks for 86%-90% attendance,4 marks for 91%-95%attendance and 5 marks for 96%-100% attendance.

2. Evaluation will be based on- attendance, class tests/assignments, and practical.

3. Students must attend all the above-listed evaluation components.

4. To receive the course completion certificate, students must secure a minimum of 40% aggregate marks.

5. The percentage of Marks secured by students will be converted into a Grade as follows-

   40%-50%: Grade A

   30%-40%: Grade B

   20%-30%: Grade C