

## **Course Title: Certificate Course in Scientific Computing using Python**

**Course Duration: 30 hours**

### **Course Description:**

Scientific Computing using Python is a comprehensive certificate course that introduces participants to the fundamental concepts and practical applications of Python programming in the field of scientific computing. The course focuses on leveraging Python's versatility and popular libraries, such as NumPy, SciPy, and Matplotlib, to perform numerical computations, data analysis, and visualization for scientific purposes. Participants will gain hands-on experience and develop essential skills required for scientific computing using Python.

### **Course Objectives:**

- Understand the basics of Python programming language and its significance in scientific computing.
- Familiarize participants with the NumPy library for efficient numerical computations.
- Explore the SciPy toolbox for various scientific computing tasks.
- Learn data analysis techniques using Python.
- Develop skills for scientific data visualization using Matplotlib.
- Gain practical experience through hands-on exercises and projects.

### **Course Outline:**

#### **Module 1: Introduction to Python Programming (4 hours)**

Introduction to Python as a programming language for scientific computing  
Basic syntax and data types in Python  
Variables, loops, and conditional statements  
Functions and modules in Python  
Introduction to Jupyter Notebook for interactive coding

#### **Module 2: Numerical Computing with NumPy (8 hours)**

Introduction to NumPy and its importance in scientific computing  
NumPy arrays: creation, manipulation, and indexing  
Mathematical operations with NumPy arrays  
Linear algebra with NumPy  
Array broadcasting and vectorization  
NumPy functions for statistics and random number generation

#### **Module 3: Scientific Computing with SciPy (10 hours)**

Introduction to the SciPy library and its modules  
Numerical integration and optimization with SciPy  
Solving linear and nonlinear equations with SciPy  
Statistical analysis with SciPy  
Signal processing using SciPy  
Image processing and manipulation with SciPy

#### **Module 4: Data Analysis and Visualization with Matplotlib (8 hours)**

- Introduction to data analysis in Python
- Data manipulation with Pandas library
- Data visualization using Matplotlib
- Creating line plots, scatter plots, histograms, and bar plots
- Customizing plots with labels, titles, and legends
- Creating subplots and multiple plots

#### **Module 5: Project Work (2 hours)**

Participants will work on a project applying the concepts learned throughout the course  
They will analyze and visualize scientific data using Python libraries  
Participants will present their projects to the class, sharing their findings and experiences  
Note: The course outline is subject to customization and adjustment based on the specific requirements and pace of the participants.

#### **Assessment:**

- Regular in-class exercises and quizzes to gauge understanding and progress.
- Completion of a project demonstrating the application of Python in scientific computing.
- Overall participation and engagement in class activities and discussions.

#### **Prerequisites:**

- Basic understanding of programming concepts would be beneficial.
- Familiarity with mathematical and scientific concepts will be advantageous, although not mandatory.

#### **Certificate:**

Upon successful completion of the course and assessment criteria, participants will be awarded a certificate in Scientific Computing using Python.