D 122529 **(Pages : 2)** **Name.....**

Reg. No.....

SECOND SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION, APRIL 2025

(CBCSS)

Physics

PHY 2C 08—COMPUTATIONAL PHYSICS

(2019 Admission onwards)

Time : Three Hours Maximum : 30 Weightage

Section A

Answer **all** *questions.*
Each question carries 1 *weightage.*

1. What is Python's primary advantage as a high-level programming language ?
2. What is the purpose of a variable in Python ?
3. How does the NumPy module facilitate array creation in Python ?
4. Give an example of a plot that can be generated using matplotlib.
5. Name one method for solving simultaneous equations using Python.
6. Name one method for approximating derivatives numerically.
7. Define a tuple in Python.
8. What is the difference between a compiler and an interpreter ?

(8 × 1 = 8 weightage)

Section B

Answer any **two** *questions.*
Each question carries 5 *weightage.*

9. Explore the concept of interpolation in numerical analysis. Discuss the importance of interpolation techniques in approximating functions from discrete data points. Compare and contrast linear interpolation with polynomial interpolation, highlighting their advantages and limitations.
10. Discuss the significance of derivatives in numerical methods. Explain how derivatives are approximated numerically using finite difference methods and polynomial interpolation.

Turn over

11. Analyse the process of solving ordinary differential equations (ODEs) using numerical methods. Discuss the Euler method, Runge-Kutta methods, and other techniques for integrating ODEs numerically.

12. Discuss the importance of Monte Carlo simulations in scientific computing. Explain the basic principles of Monte Carlo methods and their applications in solving complex problems such as integration.

(2 × 5 = 10 weightage)

Section C

Answer any **four** *questions.*
Each question carries 3 *weightage.*

13. Write a Python program that takes two numbers as input from the user and performs the operations Addition, Subtraction, Multiplication, Division and print the result of each operation to the console.

14. Create a NumPy array of shape $(3, 3)$ filled with zeros using Python.

15. Programme to plot a sine function with x-values ranging from 0 to 2π using matplotlib.

16. Given the data points $(1, 3), (2, 5)$ and $(3, 7)$, write programme to perform linear interpolation to estimate the value at $x = 2.5$.

17. Programme to approximate the derivative of the function $f(x) = x^2$ at $x = 3$ using the forward difference method with a step size of 0.1.

18. Programme to solve the initial value problem $dy/dx = x^2 + y^2$ with $y(0) = 1$ using the Runge-Kutta method with a step size of 0.1 from $x = 0$ to $x = 1$.

19. Estimate the value of 'π' using a Monte Carlo simulation with 1000 random points within a unit square, assuming uniform distribution using Python codes.

(4 × 3 = 12 weightage)