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(Pages : 2)

Name.....

Reg. No.....

**SECOND SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY)  
EXAMINATION, APRIL 2024**

(CBCSS)

Physics

PHY2C08—COMPUTATIONAL PHYSICS

(2019 Admission onwards)

Time : Three Hours

Maximum : 30 Weightage

**Section A***Answer all questions, each carries weightage 1.*

1. What is Python's primary advantage as a high-level programming language ?
2. How does the NumPy module facilitate array creation in Python ?
3. What is the matplotlib module used for in Python ?
4. What is interpolation, and why is it used in numerical methods ?
5. Name one method for solving simultaneous equations using Python.
6. What is the difference between a list and a tuple in Python ?
7. Provide one example of a problem that can be solved using Monte Carlo simulations.
8. How do you define a function in Python ?

(8 × 1 = 8 weightage)

**Section B***Answer any two questions, each carry weightage 5.*

9. Discuss the significance of data visualization in exploratory data analysis. Explain how visualizing data using matplotlib in Python helps analysts gain insights into datasets, identify patterns, and communicate findings effectively. Provide examples of data visualization techniques such as scatter plots, histograms, or heatmaps and discuss their applications in data analysis.
10. Explain how the first-order Euler method can be implemented in Python for solving initial value problems in differential equations. Discuss the algorithmic steps involved in the Euler method, including the calculation of slopes and the iterative updating of the solution.

**Turn over**

526702

11. Highlight the advantages of using Lagrange and Newton difference polynomials for approximation in Python programming, emphasizing their simplicity and efficiency in computations.
12. Discuss the role of Python in conducting computational simulations of quantum phenomena. how Python libraries such as NumPy and SciPy can be utilized to solve the 1D Schrodinger equation numerically.

(2 × 5 = 10 marks)

### Section C

Answer any **four** questions, each carry weightage 3.

13. Write a Python code to concatenate two strings: "Hello" and "World".
14. Write a Python programme to create a  $3 \times 3$  identity matrix using NumPy.
15. Write a Python programme that defines a function to calculate the factorial of a given number using recursions.
16. Write a Python programme to plot a sine function with  $x$ -values ranging from 0 to  $2\pi$  using matplotlib.
17. Estimate the integral  $\int_0^1 x^2 dx$  using the trapezoidal rule with 4 intervals.
18. Solve the initial value problem  $dy/dx = 2x - y$  with  $y(0) = 1$  using the fourth-order Runge-Kutta method with a step size of 0.1 from  $x = 0$  to  $x = 1$ .
19. Estimate the value of  $\pi$  using a Monte Carlo simulation with 10000 random points within a circle, assuming uniform distribution.

(4 × 3 = 12 marks)