

SECOND SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2025
(Regular/Improvement/Supplementary)

PHYSICS
FPHY2C08: COMPUTATIONAL PHYSICS

Time: 3 Hours**Maximum Weightage: 30**

Part A: Short answer questions. Answer *all* questions. Each carries 1 weightage.

1. What are compilers and interpreters?
2. With the help of an example, explain how reshape function can be used for creating an array.
3. List out the steps involved in linear least-square fitting.
4. Explain the interpolation with cubic spline and give its merits.
5. Describe the shooting method for solving a second order differential equation
6. Explain Predictor-Corrector method for solving differential equations. How it is different from Euler Method?
7. What are the advantages and disadvantages of solving physical problems using computational techniques?
8. Explain the relation between accuracy and stepsize in a program.

(8 × 1 = 8 weightage)

Part B: Essay questions. Answer any *two* questions. Each carries 5 weightage.

9.
 - a) Explain how different types of plots can be generated using **matplotlib** package in Python with suitable examples.
 - b) Explain how Fourier theorem can be explained using this.
10. Explain trapezoidal and Simpson's method of computing integral.
11. Briefly discuss about discrete and fast Fourier transforms and explain the steps involved in solving them numerically.
12. Discuss the method of solving a simple harmonic oscillator equation numerically using Euler's equation and write a Python program for finding the solution of simple harmonic oscillator equation.

(2 × 5 = 10 weightage)

(P.T.O.)

Part C: Problems. Answer any *four* questions. Each carries 3 weightage.

13. What are List data types in Python. Discuss any five built-in list functions with the help of examples
14. Explain the different file operations used in python. Explain writing to a file, read from a file and append to a file with the help of example.
15. Write a python program to solve the following set of equations.
$$\begin{aligned}x + 2y + z &= 10 \\ 2x + y + 2z &= 5 \\ -x + 2y + z &= 6\end{aligned}$$
16. How do you represent a square wave using Fourier series? Write a Python program to generate square wave using Fourier series.
17. Find a real root of the equation correct to three decimal places, by the method of false position: $x^3 - 5x + 1 = 0$.
18. Use fourth order Runge-Kutta method for numerically solving the initial value problem $\frac{dy}{dx} = x+y$ with $y(0) = 1$ and find y in the interval $0 \leq x \leq 0.4$ with $h = 0.1$.
19. Discuss how Monte-Carlo method can be used to study the problem of radioactive decay. Write a program for this.

(4 × 3 = 12 weightage)