D2APH2004 **(2 Pages)** **Name.....**

Reg.No.....

SECOND SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2021

PHYSICS

FPHY2C08: COMPUTATIONAL PHYSICS

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

Part A: Short answer questions. *All* questions can be answered. Each carries *one* weightage (Ceiling 6 weightage).

1. Distinguish between list and dictionary. Give examples for using these.
2. Discuss different data types in Python language with examples.
3. What is a Python module? Explain usage of modules in Python with suitable examples.
4. Mention any four methods for handling polynomials in Python language .
5. Explain the method of finding the root of transcendental equation using False position method.
6. Explain Predictor-Corrector method for solving differential equations. How it is different from Euler method?
7. Discuss the numerical method of solving the problem of a freely falling body using numerical technique.
8. What is meant by Monte-Carlo method? Explain the method evaluating the value of π using Monte-Carlo method.

Part B: Essay questions. *All* questions can be answered. Each carries *six* weightage (Ceiling 12 weightage).

9. (a) Explain how different types of plots can be generated using ***matplotlib*** package in Python.

   (b) Explain how Fourier theorem can be explained using this.
10. Starting from Euler equations, derive 2^{nd} order Runge-Kutta equations. Briefly discuss 4^{th} order Runge-Kutta method and explain the method of solving higher order differential equations.

(PTO)

11. (a) Briefly discuss the method involved in fitting data to an exponential curve and finding the fit parameters.

    (b) Fit the following set of data to $y = e^{(a+bx)}$

x	2.00	2.40	2.80	3.20	3.60	4.00
y	9964.71	6208.69	2924.83	1735.90	1185.91	490.93

12. Distinguish between analytical and numerical methods of solving physical problems. With necessary theory, develop a program for studying the dynamics of a particle confined in a box, by solving Schrödinger equation.

Part C: Problems. *All* questions can be answered. Each carries *four* weightage. (Ceiling 12 weightage)

13. With necessary theory, write a Python program for evaluating e^x using Taylor series expansion accurate to four decimal places.
14. Develop a Python program to solve the quadratic equation which can accommodate real and complex roots.
15. The velocity of a train which starts from rest is given in the following table. Estimate the distance travelled in 20 minutes.

t (min)	2	4	6	8	10	12	14	16	18	20
V(miles/min)	10	18	25	29	32	20	11	5	2	0

16. With necessary theory, write a program for plotting Bessel function of a given order.
17. From the following data compute the value of $log_{10}323.5$ using Lagrange's interpolation formula.

x	321.0	322.8	324.2	325.0
$log_{10}\, x$	2.50651	2.50893	2.51081	2.51188

18. Solve the ordinary differential equation $\frac{dy}{dx} = x + y$, using fourth order Runge-Kutta method. With initial condition y(0)= 2, find y(0. 1) with h= 0.1. Compare the result with the exact solution y = 3 $e^x - x - 1$.
19. Discuss how Monte-Carlo methods can be used to study the problem of radioactive decay. Write a Python program for this.