2021

PHYSICS-HONOURS-PRACTICAL

Paper: CC-5-P

Full Marks-30

Answer *any one* question.

[Write the code in pen and paper only. No computer output or plot is required.]

1. i) Find the value of y at x=0.18 using Lagrange's interpolation formula.

x	0.05	0.10	0.15	0.20	0.25	0.35
y	0.95	0.86	0.82	0.78	0.70	0.67

Program: 8, Algorithm: 3

ii) Given $f(x) = 3 + 2sin\frac{x^2}{2}$ at $x = [2, 4, 6, 8, 10]$. Interpolate the function in the range $x = [0,10]$ with Δx=0.1 using Lagrange interpolating polynomial from scipy. Plot the given data points, true values and the interpolated values at required data points using matplotlib. Label the axes as X and Y and put title 'Lagrange Interpolation'.

Program: 8, Algorithm: 3

iii) Create a one dimensional numpy array with 6 random numbers between [0,10]. Reshape this into a 2×3 two dimensional array. Treat this as a matrix and transpose it. Find trace.

Program: 6, Algorithm: 2

2. i) Find the value of f(x) at x=12 using Newton's interpolation formula.

x	5	10	15	20	25	30
f(x)	45	105	174	259	364	496

Program: 8, Algorithm: 3

ii) Given $f(x) = 3e^{2x} + \cos x$ at $x = [1, 2, 3, 4, 5]$. Interpolate the function in the range $x = [0,5]$ with Δx=0.1 using *scipy.interpolate*. Plot the given data points, true values and the interpolated values at required data points using matplotlib. Label the axes as X and Y and put title 'Linear Interpolation'.

Program: 8, Algorithm: 3

iii) Plot $y = \sin x \cos \frac{x}{2}, y = \sin x \cos x, y = \sin \frac{x}{2} \cos x$ in the same graph in x range [0,10] with colors red, green, blue and different linestyles and linewidths using matplotlib. Label the axes as X and Y. Set X limit [0,10] and Y limit [-1.5,1.5]. Put legend at bottom right and Put title 'My graph'. Put a text 'Trigonometric Functions' inside the plot. Plot grid.

Program: 6, Algorithm: 2

3. i) Find the value of integral $\int_0^1 \sqrt{1 - x^2} dx$ using the function quad().

Program: 4, Algorithm: 2

ii) Find the integral $\int_0^{\frac{\pi}{2}} \sin x \cos x \, dx$ using simps(), quad() and trapz() in a single program and compare with the true value $\frac{1}{2}$.

Program: 12, Algorithm: 5

iii) Given a numpy array [[1, 2, 3,4,5], [0, 1, 2,3,4]] treat the first element as x-data and the second element as y-data. Plot y^2 vs. x through matplotlib. Put color, linestyle and linewidth. Label the axes as 'X-Data' and 'Y-Data' and set title as 'Experimental plot'.

Program: 5, Algorithm: 2

4. i) Create a numpy array of 8 equally spaced numbers between [0, 20]. Print the array. Take numbers with index no. 2 to 5 by slicing.

Program: 5, Algorithm: 2

ii) Solve $\frac{dy}{dx} = y - e^x \sin x$, $y(0) = 1$ by 4th order Runge Kutta method. Plot y vs x in the range [0,10] using matplotlib.

Program: 6, Algorithm: 4

iii) Create equidistant points between [0,10] and plot the true solution of the above equation which is $y = e^x \cos x$ in the same plot. Label the axes as 'X axis' and 'Y axis'. Put blue color in RK solution and red color in true solution. Use different linestyles. Label the plots as 'True solution' and 'RK4 solution'. Put legend. Name the figure as 'Solution by RK4 method'.

Program: 10, Algorithm: 3

-------End of question paper-------