

2017

PHYSICS

(Comp. Lab.)

(Practical)

[Honours]

(CBCS)

PAPER – C1P

Full Marks : 20

Time : 2 hours

The questions are of equal value

[Exp. : 15, LNB = 02, V.V. = 03]

- Write the necessary formula.
- Write the Computer Code (in PYTHON or in C) clearly.
- Print the Input and Output.
- Display your result graphically if asked.

Attempt any one set of questions from the following

1. (i) Write a Computer program to find the trace $Tr(A)$ of the following matrix :

$$A = \begin{pmatrix} 3 & 4 & 8 \\ 5 & 9 & 2 \\ 1 & 6 & 0 \end{pmatrix}$$

- (ii) Compute the value of π from the formula :

$$\frac{\pi}{4} = \int_0^1 \frac{dx}{1+x^2}$$

Use composite Simpson's 1/3 rule to evaluate with an accuracy of the order of 10^{-5} .

2. (i) Write a program for bifurcation method to determine at least one root of the equation : $x^4 - 1.99x^3 - 1.76x^2 + 5.22x - 2.23 = 0$ which is close to $x = 1.5$.

- (ii) Given some data : $x = 87, 91, 85, 75, 28, 122, 66, 56$, find the (arithmetic) mean and r.m.s. value of the variable x .

3. (i) Calculate the value of the elliptic integral of the first kind :

$$K(0.25) = \int_0^{\pi/2} \frac{dx}{\sqrt{1 - 0.25 \sin^2 x}}$$

Divide the interval $[0, \pi/2]$ into 1000 equal parts and use composite Trapezoidal rule to evaluate the integral.

- (ii) A set of 20 numbers are given : 1, 0.1, 5, 3, 10, -1, 4, 20, 1000, -9, 2, 14, 4.5, 0.9, 30, 9.8, 11, 22, 48, -10. Write a computer program to count how many numbers are there between 0 to 10.
4. (i) Write a program to verify approximately, $\ln 100! \approx 100 \ln 100 - 100$.
- (ii) The temperature θ of a well stirred liquid by the isothermal heating coil is given by the equation :

$$\frac{d\theta}{dt} = K(100 - \theta),$$

where K is a constant of the system. Write a computer program to solve the equation by Runge-Kutta fourth order method to find θ at $t = 1.0$ sec for $K = 2.5$. Initial condition ; $\theta = 25^\circ\text{C}$ at $t = 0$ sec.

5. (i) Write a computer program to compute $n!$, where $n = 10$.
- (ii) Write a computer program to evaluate $f(15)$, given the following table of values :

x	10	20	30	40	50
$y = f(x)$	46	66	81	93	101

6. (i) Write a computer program to solve the differential equation for damped harmonic motion :

$$\frac{d^2y}{dx^2} + 2 \cdot \frac{dy}{dx} + y = 0, \text{ with } y(0) = 0, x(0) = 0, y'(0) = 1.0$$

Print the values of (x, y) in a data file and plot the graph through Gnuplot.

[Computer code may be written following Euler's Method or RK2 or RK4.]

- (ii) Write a computer program for the function $f(x) = (x-1)(x-2)(x-3)(x-4)(x-5)$ then evaluate $f(6)$ from that.

7. (i) Write a computer program where you utilize random number generator to evaluate the value of π with the level of accuracy of 10^{-4} .

(ii) Compute :

$$\binom{N}{n} = \frac{N!}{n!(N-n)!}$$

for $N = 7, n = 3$.

8. (i) Compute numerically the following integral to verify the answer or obtain a value close to that :

$$\int_0^{\pi} \frac{x}{x^2 + 1} \cos(10x^2) = 0.0003156$$

Write a computer program for the above, following composite Simpson's 1/3rd rule.

- (ii) Write a computer program to find out the sum of digits of 87694.

9. (i) The distance travelled by a car in km, at intervals of 2 min. are given as follows :

Time (m)	2	4	6	8	10
Distance (km)	0.75	2.00	3.50	5.35	8.00

Write a suitable computer program to evaluate the velocity at $T = 5$ min.

- (ii) Given the recursion relation : $x_{n+1} = x_n + x_{n-1}$, with $x_0 = x_1 = 1$. Write a suitable computer program to generate all the values up to x_{15} .
10. (i) Write a computer program following Newton-Raphson method to find out a real root of the equation : $\cos x = 3x - 1$, around $x \approx 1$.
- (ii) Given a function, $y = f(x) = 2x^3 \exp(-x^2)$, generate some (x, y) data points for the x range $(0, 20)$, store in a file and then plot with 'Gnuplot' software.

11. (i) Find the value of π from the infinite series :

$$\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} + \dots$$

up to 6th decimal of accuracy.

- (ii) Consider the error function,

$$\operatorname{erf}(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2} dt,$$

the values of which are given as following :

x	1.0	1.2	1.4	1.6	1.8	2.0
erf (x)	0.84270	0.91031	0.95229	0.97635	0.98909	0.99532

Write a forward or backward difference interpolation program to calculate the value of $\operatorname{erf}(1.433)$.

12. (i) Compute this : $\int_{1.8}^{3.4} f(x) dx$, where we have

x	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4
f(x)	6.050	7.389	9.025	11.023	13.464	16.445	20.086	24.533	29.964

- (ii) Write a computer program to compute the variance of 5 numbers : -2, 0, 1, 6, 4.