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B.Sc.-CBCS/IS/PHS/H/C1P/17
(Pr.)

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

(*Turn Over*)

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 : $x^4 - 1{\cdot}99x^3 - 1{\cdot}76x^2 + 5{\cdot}22x - 2{\cdot}23 = 0$ which is close to $x = 1{\cdot}5$.

(*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 :

$$K(0{\cdot}25) = \int_0^{\pi/2} \frac{dx}{\sqrt{1 - 0{\cdot}25\sin^2 x}}$$

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 $t = 1{\cdot}0$ sec for $K = 2{\cdot}5$. Initial condition : $\theta = 25\ ^\circ C$ 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 :

$$\frac{d^2y}{dx^2} + 2 \cdot \frac{dy}{dx} + y = 0, \text{ with } y(0) = 0, x(0) = 0, y'(0) = 1 \cdot 0$$

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 :

$$\int_0^{\pi} \frac{x}{x^2+1} \cos(10x^2) = 0 \cdot 0003156$$

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.

(*Continued*)

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

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

up to 6th decimal of accuracy.

(*ii*) Consider the error function,

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

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 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.

MV–1,700