2016

PHYSICS — HONOURS — PRACTICAL

Eighth Paper

(Group – B)

Full Marks – 50

The figures in the margin indicate full marks

Programming Language : C or Fortran

Print the output of your programs at the terminals

Group A

1. Given an integer M (say, 3), find the smallest integer n for which the series

$$1+\frac{1}{2}+\frac{1}{3}\cdots+\frac{1}{n}$$

is larger than M.
(Flow chart/Algorithm - 2, Program - 8, Result - 2)

2. Read 10 numbers and write a program to arrange them in ascending order. Test your program for the following numbers :
1.2, -2.9, 2.1, 6.9, -9.8, 8.7, 5.1, 1.8, -3.5, -4.7
(Flow chart/Algorithm - 2, Program - 8, Result - 2)

3. Each term of a sequence $\{a_1, a_2, a_3, \cdots\}$ is generated by taking the sum of the previous three terms. If the first three terms are 0 and 1 and 2, find the ratio a_{n+1}/a_n correct to three decimal places for $n \to \infty$.
(Flow chart/Algorithm - 2, Program - 8, Result - 2)

1.839

4. The series expansion for $\log_e(x)$ in the range $x > 1$ is

$$\log_e(x)=\frac{x-1}{x}+\frac{1}{2}\left(\frac{x-1}{x}\right)^2+\frac{1}{3}\left(\frac{x-1}{x}\right)^3+\cdots$$

1.1447 ✓

Evaluate $\log_e(x)$ for $x=\pi$ up to three decimal places by using this expansion.
(Flow chart/Algorithm - 2, Program - 8, Result - 2)

5. Find the prime numbers less than or equal to 59.
(Flow chart/Algorithm - 2, Program - 8, Result - 2)

[Turn Over]

6. Four positive integers i, j, k, l, each ≤ 8, satisfy the condition $i^2 + j^2 + k^2 = l^2$. Write down all possible such sets with a program.
(Flow chart/Algorithm - 2, Program - 8, Result - 2)

1, 2, 2, 3
2, 1, 2, 3
2, 2, 1, 3
2, 3, 6, 7
2, 6, 3, 7
3, 2, 6, 7
3, 6, 2, 7
6, 2, 3, 7
6, 3, 2, 7
2, 4, 4, 6
4, 2, 4, 6
4, 4, 2, 6
12

7. Write a program to compute the matrix

$$A + \frac{1}{2}A^2 + \frac{1}{6}A^3$$

where

$$A = \begin{pmatrix} 1 & 2 \\ 2 & 1 \end{pmatrix}$$

(Flow chart/Algorithm - 2, Program - 8, Result - 2)

8. Calculate the commutator $[A, B]$, where

$$\begin{bmatrix} 0 & 0.1162 & 0.1342 \\ 0.1162 & 0 & 0.3687 \\ 0.1342 & -0.3687 & 0 \end{bmatrix}$$

$$A = \begin{pmatrix} \cos\alpha & \sin\alpha & 0 \\ -\sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{pmatrix}, \qquad B = \begin{pmatrix} \cos\beta & 0 & -\sin\beta \\ 0 & 1 & 0 \\ \sin\beta & 0 & \cos\beta \end{pmatrix}$$

with $\alpha = 40°$ and $\beta = 35°$
(Flow chart/Algorithm - 2, Program - 8, Result - 2)

~~0 0.1162 0.1342~~
~~0.1162 0 0.36~~
~~0~~

Group B

1. Use the *Gauss-Seidel* method (without rearrangement or refinement) to solve the simultaneous equations

$$\begin{aligned} 9x_1 + x_2 + x_3 + x_4 &= 75 \\ x_1 + 8x_2 + x_3 + x_4 &= 54 \\ x_1 + x_2 + 7x_3 + x_4 &= 43 \\ x_1 + x_2 + x_3 + 6x_4 &= 34 \end{aligned}$$

$x_1 = 7$
$x_2 = 5$
$x_3 = 4$
$x_4 = 3$

(Flow chart/Algorithm - 4, Program - 10, Result - 4)

2. Given the data

x	0.1	0.2	0.3	0.4	0.5	0.6
$f(x)$	0.545	0.331	0.275	0.258	0.240	0.235

0.2928

find the value of $f(x)$ for $x = 0.25$ using *Lagrange's interpolation formula* using all the points.
(Flow chart/Algorithm - 4, Program - 10, Result - 4)

3. Given the data

x	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
$f(x)$	-1.26	-1.10	-0.91	-0.67	-0.54	-0.32	-0.10	0.08	0.33	0.51

−0.369957

find the value of $f(x)$ for $x = 0.58$ using *Lagrange's interpolation formula* using all the points.

(Flow chart/Algorithm - 4, Program - 10, Result - 4)

4. Using the following data, calculate the values of m and c for *least square fit* to a straight line $y = mx + c$.

x	1	2	3	4	5	6	7	8	9	10
y	-0.94	-0.82	-0.72	-0.58	-0.49	-0.32	-0.21	-0.08	0.06	0.20

m = 0.126667
c = −1.086667

(Flow chart/Algorithm - 4, Program - 10, Result - 4)

5. Using the *bisection* method, find the root of the equation

$$x^3 - 5.816x^2 + 9.632x - 7.632 = 0$$

3.816

correct upto the third decimal place. (This equation has only one root, that lies in the range $0 < x < 5$.)

(Flow chart/Algorithm - 4, Program - 10, Result - 4)

6. Using the *bisection* method, find the root of the equation

$$20 - 2.5x - 0.01x^3 = 0$$

6.76

correct upto 3 significant digits. (This equation has only one root, that lies in the range $0 < x < 10$.)

(Flow chart/Algorithm - 4, Program - 10, Result - 4)

7. Using the *Newton-Raphson* method, find the root of the equation

$$x^2 \ln x = 5.72$$

2.499

correct upto the third decimal place. (This equation has only one root, that lies in the range $2 < x < 3$.)

(Flow chart/Algorithm - 4, Program - 10, Result - 4)

8. Using *Newton-Raphson* method, find a real root of the equation

$$x^2 - 2\exp(-x) = 0$$

0.901

correct upto 3 significant digits. (This equation has only one root, that lies in the range $0 < x < 1$.)

(Flow chart/Algorithm - 4, Program - 10, Result - 4)

9. Using *trapezoidal* rule, calculate

$$\int_0^{\pi} \sqrt{x} \exp x \, dx$$

-32.836

correct upto 3 significant digits.
(Flow chart/Algorithm - 4, Program - 10, Result - 4)

10. Using *trapezoidal* rule, calculate

$$\int_0^{\pi/4} \sqrt{1-x^2} \cos x \, dx$$

-0.6329[illegible]

correct upto 3 decimal places.
(Flow chart/Algorithm - 4, Program - 10, Result - 4)

11. Using *Simpson's one-third rule*, calculate

$$\int_0^{\pi} e^{-x^2} \sin x \, dx$$

0.424

correct upto 3 significant digits.
(Flow chart/Algorithm - 4, Program - 10, Result - 4)

12. Using *Simpson's one-third rule*, calculate

0.878

$$\int_{-1}^{1} x^2 e^x dx$$

correct upto 2 decimal places.
(Flow chart/Algorithm - 4, Program - 10, Result - 4)

2018

PHYSICS - HONOURS - PRACTICAL

Eighth Paper

(Group B)

Full Marks - 50

Set 1

Date of Examination: 12.03.2018

Programming Language : C or Fortran

Print the output of your programs at the terminals

Group A

A1 Search from 50 onwards and find the first five prime numbers. Store them in an array and calculate the sum of those five numbers.
(Flow chart / Algorithm -2, Program -8, Result -2)

A2 Sort the following ten numbers using any type of sorting algorithm in ascending order :
$1, -4.5, 6.9, -0.1, 2.3, 5, 9, 1.63, 2.76, 8.1$
(Flow chart / Algorithm -2, Program -8, Result -2)

A3 Calculate the value of $\ln(3)$ from the series expansion

$$\ln\left(\frac{1+x}{1-x}\right) = 2x + \frac{2}{3}x^3 + \frac{2}{5}x^5 + \frac{2}{7}x^7 + \cdots$$

(for $-1 < x < 1$) up to an accuracy of three decimal places.
(Flow chart / Algorithm -2, Program -8, Result -2)

A4 Find the factors of the number 4158. Separate the prime factors from the list and print them.
(Flow chart / Algorithm -2, Program -8, Result -2)

A5 Consider the series

$$\frac{1}{2\cdot 3} + \frac{2}{3\cdot 4} + \frac{3}{4\cdot 5} + \cdots$$

Calculate the sum of the series up to 8 terms.
(Flow chart / Algorithm -2, Program -8, Result -2)

[Turn Over]

A6 Take the two lists $a(1) = 2, a(2) = 2.3, a(3) = 3, a(4) = 3.4, a(5) = 4$ and $b(1) = 7, b(2) = 7.2, b(3) = 7.3, b(4) = 7.4, b(5) = 7.5$. After taking the input from the screen and storing two lists create a separate (say c) list of 10 elements taking one from the lists a and b alternatively. i.e.,
$c(1) = a(1), c(2) = b(1), c(3) = a(2), c(4) = b(2) \ldots\ldots, c(9) = a(5), c(10) = b(5)$
Print the three lists.
(Flow chart / Algorithm -2, Program -8, Result -2)

A7 It is given that $A = \begin{pmatrix} 3 & 5 \\ 1 & 2 \end{pmatrix}$ and $B = \begin{pmatrix} 2 & -5 \\ -1 & 3 \end{pmatrix}$. Find the products AB and BA.
(Flow chart / Algorithm -2, Program -8, Result -2)

A8 If $A = \begin{pmatrix} -3 & 1 \\ -4 & 2 \end{pmatrix}$, calculate $A^2 + A$.
(Flow chart / Algorithm -2, Program -8, Result -2)

Group B

B1 Use the *Gauss-Seidel* method (without rearrangement or refinement) to solve the simultaneous equations

$$\begin{aligned} 8x_1 + 4x_2 - 2x_3 &= 3 \\ 2x_1 - 4x_2 + x_3 &= 1 \\ 3x_1 + x_2 + 7x_3 &= 11 \end{aligned}$$

(Flow chart / Algorithm -4, Program -10, Result -4)

B2 Find the value of $f(x)$ for $x = 3.5$ using Lagrange's interpolation formula using all the data.

x	1.3	2.7	3.1	3.9	4.2	5.3
$f(x)$	3.901	60.759	88.763	171.747	213.624	427.541

(Flow chart / Algorithm -4, Program -10, Result -4)

B3 Using the following data, calculate the values of m and c for *least square fit* to a straight line $y = mx + c$.

x	1.5	1.75	2.27	2.81	3.19	4.7	5.32	7.24
y	19.14	19.00	18.70	18.40	18.18	17.32	16.90	15.87

(Flow chart / Algorithm -4, Program -10, Result -4)

B4 Using the following data, calculate the value of m for *least square fit* to a straight line $y = mx$

x	-5.2	-4.1	-3.5	-2.1	1.68	4.6	7.4
y	-27.04	-21.32	-18.2	-10.9	8.74	23.9	38.48

(Flow chart / Algorithm -4, Program -10, Result -4)

B5 Using the *bisection* method, find the root of the equation

$$2(x-5)^2 - 10x = 11$$

that lies in the range $1.0 < x < 2.5$, correct up to the third decimal place.
(Flow chart / Algorithm -4, Program -10, Result -4)

B6 Using the *Newton-Raphson* method, find the root of the equation

$$x^3 + (x+1)^2 + 4x = 20$$

that lies in the range $1.0 < x < 2.5$, correct up to three decimal places, by choosing the initial point suitably.
(Flow chart / Algorithm -4, Program -10, Result -4)

B7 Using *trapezoidal* rule, calculate

$$\int_0^5 e^{-x^2} x^2 dx$$

correct up to 2 decimal places.
(Flow chart / Algorithm -4, Program -10, Result -4)

B8 Using *Simpson's one-third rule*, calculate

$$\int_{-2}^{2} x^3 e^{-x} dx$$

correct up to 2 decimal places.
(Flow chart / Algorithm -4, Program -10, Result -4)

2018

PHYSICS - HONOURS - PRACTICAL

Eighth Paper

(Group B)

Full Marks - 50

Set 2

Date of Examination: 13.03.2018

Programming Language : C or Fortran

Print the output of your programs at the terminals

Group A

A1 Start from 3993 and find six consecutive prime numbers less than 3993. Store them in an array and find the sum of those six numbers.
(Flow chart / Algorithm -2, Program -8, Result -2)

A2 Sort the following ten numbers using any type of sorting algorithm in ascending order:
$2.3, 5.6, -8.4, 10.6, -2.5, 8.7, 9.44, 11.25, 50.24, 1.5$.
(Flow chart / Algorithm -2, Program -8, Result -2)

A3 Generate the Fibonacci sequence $F_{i+1} = F_i + F_{i-1}$. ($i \geq 2$, $F_2 = 1$ and $F_1 = 1$). and calculate the reciprocal Fibonacci series

$$S = \sum_i \frac{1}{F_i}$$

up to an accuracy of four decimal places.
(Flow chart / Algorithm -2, Program -8, Result -2)

A4 Factories 168 and calculate the product of all the non-prime factors.
(Flow chart / Algorithm -2, Program -8, Result -2)

A5 It is known that

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$$

Calculate the partial sum S_n and determine the number of terms for which $\frac{\pi^2}{6} - S_n = 0.0001$.
(Flow chart / Algorithm -2, Program -8, Result -2)

[Turn Over]

A6 A list of numbers is given below

$3.1, -6.4, 5.21, 7.2, -9.11, -11.1, 3.45, -4.52, -2.53, -8.87$

Accept the numbers from the screen and store in an array. Then form two separate lists such that one contains the negative numbers and other contains the positive numbers. (No need to arrange them.)

Print the three lists.

(Flow chart / Algorithm -2, Program -8, Result -2)

A7 A matrix is defined as $A = \begin{pmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{pmatrix}$, where $\theta = 30^0$. Construct $B = A^T$ and find the product BA.

(Flow chart / Algorithm -2, Program -8, Result -2)

A8 If $A = \begin{pmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{pmatrix}$, calculate $A^2 - 4A$.

(Flow chart / Algorithm -2, Program -8, Result -2)

Group B

B1 Use the *Gauss-Seidel* method (without rearrangement or refinement) to solve the simultaneous equations

$$\begin{aligned} 12x_1 + 3x_2 - 5x_3 &= 1 \\ x_1 + 5x_2 + 3x_3 &= 28 \\ 3x_1 + 7x_2 + 13x_3 &= 76 \end{aligned}$$

(Flow chart / Algorithm -4, Program -10, Result -4)

B2 Find the value of $f(x)$ for $x = -2.5$ using Lagrange's interpolation formula using all the data.

x	-3.5	-3.0	-2.75	-2.1	-1.9	-1.7
$f(x)$	-3.125	-14.0	-17.703	-22.739	-23.141	-23.087

(Flow chart / Algorithm -4, Program -10, Result -4)

B3 Using the following data, calculate the values of m and c for *least square fit* to a straight line $y = mx + c$.

x	-2.0	-1.5	2.1	4.44	5.17	6.85	7.53
y	6.92	6.86	6.0	5.44	5.25	4.86	4.72

(Flow chart / Algorithm -4, Program -10, Result -4)

B4 Using the following data, calculate the value of m for *least square fit* to a straight line $y = mx$:

x	6.31	7.2	8.3	9.1	10.6	11.2	13.6
y	19.5	22.32	25.73	28.27	32.86	34.72	42.16

(Flow chart / Algorithm -4, Program -10, Result -4)

B5 Using the *bisection* method, find the root of the equation

$$(x+5)^2 + 10x - 11 = 0$$

that lies in the range $-1.5 < x < 0$, correct up to the third decimal place.
(Flow chart / Algorithm -4, Program -10; Result -4)

B6 Using the *Newton-Raphson* method, find the root of the equation

$$e^x + 20x^6 - 25x + 2 = 0$$

that lies in the range $-0.5 < x < 0.5$, correct up to three decimal places, by choosing the initial point suitably.
(Flow chart / Algorithm -4, Program -10, Result -4)

B7 Using *trapezoidal* rule, calculate

$$\int_1^{3\pi} \frac{\sin x}{x^2} dx$$

correct up to 3 decimal places.
(Flow chart / Algorithm -4, Program -10, Result -4)

B8 Using *Simpson's one-third rule*, calculate

$$\int_0^1 x\sqrt{1-x^2}dx$$

correct up to 3 decimal places.
(Flow chart / Algorithm -4, Program -10, Result -4)

2018

PHYSICS - HONOURS - PRACTICAL

Eighth Paper

(Group B)

Full Marks - 50

Set 4

Date of Examination: 15.03.2018

Programming Language : C or Fortran

Print the output of your programs at the terminals

Group A

A1 Find the first three prime numbers n greater than 4 and check whether $2^n - 1$ is prime.
(Flow chart / Algorithm -2, Program -8, Result -2)

A2 Sort the following ten numbers using any type of sorting algorithm in ascending order:
99.23, 44.55, 65.21, 88.44, 23.21, 35.47, 15.46, 111.2, 77.52, 10.24
(Flow chart / Algorithm -2, Program -8, Result -2)

A3 Calculate the sum

$$\sum_{k=0}^{\infty} \frac{1}{n^k}$$

for $n = 2$ with an accuracy of three decimal places.
(Flow chart / Algorithm -2, Program -8, Result -2)

A4 Find the factors of the number 30030 and calculate the sum of all the prime factors.
(Flow chart / Algorithm -2, Program -8, Result -2)

A5 It is known that

$$1 - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \cdots\cdots = \frac{\pi^2}{12}$$

Calculate the partial sum S_n and determine the number of terms for which $\frac{\pi^2}{12} - S_n = 0.0001$.
(Flow chart / Algorithm -2, Program -8, Result -2)

[Turn Over]

A6 Accept any twelve numbers from the screen and store them in an array [$a(i)$ say].
Create two separate lists $b(i)$ and $c(i)$ in the following way:
$b(1) = a(6), b(2) = a(5), \ldots \ldots \; b(6) = a(1)$ and
$c(1) = a(12), c(2) = a(11), \ldots \ldots \; c(6) = a(7)$
Print the three lists.
(Flow chart / Algorithm -2, Program -8, Result -2)

A7 $A = \begin{pmatrix} 1 & 2 & 1 \\ 2 & 2 & 5 \\ 1 & 5 & 2 \end{pmatrix}, B = \begin{pmatrix} 1 & 3 & 2 \\ -3 & 1 & -1 \\ -2 & 1 & 1 \end{pmatrix}$. Calculate the sum of all the elements of AB.
(Flow chart / Algorithm -2, Program -8, Result -2)

A8 $A = \frac{1}{2}\begin{pmatrix} -1 & \sqrt{3} \\ \sqrt{3} & 1 \end{pmatrix}, B = \frac{1}{2}\begin{pmatrix} -1 & -\sqrt{3} \\ -\sqrt{3} & 1 \end{pmatrix}$. Calculate A^2 and B^2.
(Flow chart / Algorithm -2, Program -8, Result -2)

Group B

B1 Use the *Gauss-Seidel* method (without rearrangement or refinement) to solve the simultaneous equations

$$\begin{aligned} 12x_1 + 3x_2 - 2x_3 &= 8 \\ x_1 - 9x + 2x_3 &= 7 \\ x_1 + 5x_2 + 7x_3 &= -5 \end{aligned}$$

(Flow chart / Algorithm -4, Program -10, Result -4)

B2 Find the value of $f(x)$ for $x = -3.5$ using Lagerange's interpolation formula using all the data.

x	-5	-4.8	-4.2	-3.7	-3.22	-2.95
$f(x)$	57.0	54.968	46.472	37.357	27.609	21.950

(Flow chart / Algorithm -4, Program -10, Result -4)

B3 Using the following data, calculate the values of m and c for *least square fit* to a straight line $y = mx + c$.

x	2	3	4	5	6	7	8
y	-8.7	-10.4	-12.1	-13.8	-15.5	-17.2	-18.9

(Flow chart / Algorithm -4, Program -10, Result -4)

B4 Using the following data, calculate the value of m for *least square fit* to a straight line $y = mx$

x	-16.2	-9.67	-4.3	10.9	18.7	21.3	23.8
y	37.81	22.57	10.04	-25.44	-43.64	-49.72	-55.54

(Flow chart / Algorithm -4, Program -10, Result -4)

B5 Using the *bisection* method, find the root of the equation

$$\cos^2 x - 5.6x^2 + x + 20 = 0$$

that lies in the range $1 < x < 2.5$, correct up to the third decimal place.
(Flow chart / Algorithm -4, Program -10, Result -4)

B6 Using the *Newton-Raphson* method, find the root of the equation

$$\sin^2 x - 5x + 9 = 0$$

that lies in the range $1 < x < 2.5$, correct up to three decimal places, by choosing the initial point suitably.
(Flow chart / Algorithm -4, Program -10, Result -4)

B7 Using *trapezoidal* rule, calculate

$$\int_{-1}^{2} xe^{-x^2} dx$$

correct up to 3 decimal places.
(Flow chart / Algorithm -4, Program -10, Result -4)

B8 Using *Simpson's one-third rule*, calculate

$$\int_{-\pi/3}^{\pi/3} x^3 \tan x dx$$

correct up to 3 decimal places.
(Flow chart / Algorithm -4, Program -10, Result -4)

2018

PHYSICS - HONOURS - PRACTICAL

Eighth Paper

(Group B)

Full Marks - 50

Set 3
Date of Examination: 14.03.2018

Programming Language : C or Fortran

Print the output of your programs at the terminals

Group A

A1 Find the first three prime numbers greater than 4000 and the first three prime numbers less than 4000. Add the six numbers.
(Flow chart / Algorithm -2, Program -8, Result -2)

A2 Sort the following ten numbers using any type of sorting algorithm in ascending order.
$-5.6, -4.9, -9.6, 4.56, 6.58, 2.54, -8.95, 19.52, 7.15, 13.45$
(Flow chart / Algorithm -2, Program -8, Result -2)

A3 Evaluate the sum

$$S = \sum_{n=1}^{\infty} \left(\frac{1}{n+0.5} - \frac{1}{n+1.3} \right)$$

correct up to third place of decimal.
(Flow chart / Algorithm -2, Program -8, Result -2)

A4 Factories 168 and calculate the product of all the prime factors.
(Flow chart / Algorithm -2, Program -8, Result -2)

A5 It is known that

$$1 - \frac{1}{3^3} + \frac{1}{5^3} - \frac{1}{7^3} + \cdots\cdots = \frac{\pi^3}{32}$$

Calculate the partial sum S_n and determine the number of terms for which $\frac{\pi^3}{32} - S_n =$ 0.0001.
(Flow chart / Algorithm -2, Program -8, Result -2)

A6 Accept any twelve numbers from the screen and store them in an array [$a(i)$ say]. Create two separate lists $b(i)$ and $c(i)$ in the following way:
b contains the square root of the odd elements i.e., $b(1) = \sqrt{a(1)}$, $b(2) = \sqrt{a(3)}$ … …
c contains the square of the even elements i.e., $c(1) = a^2(2)$, $c(2) = a^2(4)$, … …
Print the three lists.
(Flow chart / Algorithm -2, Program -8, Result -2)

A7 $A = \begin{pmatrix} 1 & 0 & 2 \\ 3 & 2 & 1 \\ 1 & 5 & 2 \end{pmatrix}$; $B = \begin{pmatrix} 1 & 3 & 2 \\ 4 & 1 & 3 \\ 2 & 1 & 1 \end{pmatrix}$. Calculate the trace of AB.
(Flow chart / Algorithm -2, Program -8, Result -2)

A8 It is given that $P = \begin{pmatrix} 1 & 4 \\ -1 & 1 \end{pmatrix}$, $P^{-1} = \frac{1}{5}\begin{pmatrix} 1 & -4 \\ 1 & 1 \end{pmatrix}$ and $A = \begin{pmatrix} 5 & 4 \\ 1 & 2 \end{pmatrix}$. Evaluate $P^{-1}AP$.
(Flow chart / Algorithm -2, Program -8, Result -2)

Group B

B1 Use the *Gauss-Seidel* method (without rearrangement or refinement) to solve the simultaneous equations

$$\begin{aligned} 3x_1 + x_2 - x_3 &= 7 \\ x_1 - 5x_2 + x_3 &= -1 \\ 2x_1 + x_2 + 6x_3 &= 4 \end{aligned}$$

(Flow chart / Algorithm -4, Program -10, Result -4)

B2 Find the value of $f(x)$ for $x = 3.5$ using Lagrange's interpolation formula using all the data:

x	2.5	2.89	3.21	3.67	3.92	4.14
$f(x)$	-1.625	-6.237	-11.976	-23.731	-32.036	-40.558

(Flow chart / Algorithm -4, Program -10, Result -4)

B3 Using the following data, calculate the values of m and c for *least square fit* to a straight line $y = mx + c$.

x	9.56	10.62	11.45	12.01	13.89	14.23	17.5
y	7.05	6.88	6.75	6.66	6.38	6.33	5.82

(Flow chart / Algorithm -4, Program -10, Result -4)

B4
B5
B6
B
B

x	-4.4	-3.3	-2.2	-1.1	1.05	2.4	3.12
y	5.28	3.96	2.64	1.32	-1.26	-2.88	-3.74

(Flow chart / Algorithm -4, Program -10, Result -4)

B5 Using the *bisection* method, find the root of the equation

$$3\sin x - 3.5 = 5\cos x$$

that lies in the range $3 < x < 4$, correct up to the third decimal place.
(Flow chart / Algorithm -4, Program -10, Result -4)

B6 Using the *Newton-Raphson* method, find the root of the equation

$$3\cos x + x^3 = 0$$

that lies in the range $-1.5 < x < -0$, correct up to three decimal places, by choosing the initial point suitably.
(Flow chart / Algorithm -4, Program -10, Result -4)

B7 Using *trapezoidal* rule, calculate

$$\int_2^{3.7} x^4 \ln x \, dx$$

correct up to 3 significant digits.
(Flow chart / Algorithm -4, Program -10, Result -4)

B8 Using *Simpson's one-third rule*, calculate

$$\int_{-0.5}^{0.8} x^3\sqrt{1 - x^2}\, dx$$

correct up to 3 decimal places.
(Flow chart / Algorithm -4, Program -10, Result -4)

2019

PHYSICS — HONOURS — PRACTICAL

Eighth Paper

(Group – B)

Full Marks : 50

(under 1+1+1 system)

Date of Examination : 05.03.2019

Programming Language : C or Fortran.

Print the output of your programs at the terminals.

SET – 1

Group – A

A1. Write a program to find the first N prime numbers (2, 3, 5,...). Write your output for $N = 10, 17, 23$.
(Flowchart / Algorithm – 2, Program – 8, Result – 2)

A2. Sort the following ten numbers using any type of sorting algorithm in ascending order :
1, $(4.5)^2$, 6.9, – 0.1, 2.3, 5, 5, 9, $\sqrt{1.63}$, 2.76, 8.1^3
(Flowchart / Algorithm – 2, Program – 8, Result – 2)

A3. Calculate the value of ln(1.5) from the series expansion

$$\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} + ...$$

up to an accuracy of three decimal places.
(Flowchart / Algorithm – 2, Program – 8, Result – 2)

Please Turn Over

A4. Find the largest prime number below 5000.
(Flowchart / Algorithm – 2, Program – 8, Result – 2)

A5. Write a program to compute

$$S = \frac{1.2}{3.4} + \frac{5.6}{7.8} + \frac{9.10}{11.12} + \ldots$$

up to n terms. Find the value of S for $n = 10$.
(Flowchart / Algorithm – 2, Program – 8, Result – 2)

A6. Fibonacci numbers F_1, F_2,... are defined by the recursion relation $F_{n+1} = F_n + F_{n-1}$ with the initial values $F_1 = 1$ and $F_2 = 1$. Find the ratio $\lim_{n\to\infty}(F_{n+1} / F_n)$ correct up to second decimal place.
(Flowchart / Algorithm – 2, Program – 8, Result – 2)

A7. Compute and print M^T and Trace $(I - M^2)$ where I is the identity matrix and

$$M = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 1 & 2 \\ 3 & 4 & 1 \end{pmatrix}$$

(Flowchart / Algorithm – 2, Program – 8, Result – 2)

A8. Calculate the commutator $[A, B]$, where

$$A = \begin{pmatrix} 1 & 2 & 3 \\ 2 & 3 & 4 \\ 3 & 4 & 1 \end{pmatrix}, \quad B = \begin{pmatrix} 11 & 12 & 13 \\ 12 & 13 & 14 \\ 13 & 14 & 11 \end{pmatrix}$$

(Flowchart / Algorithm – 2, Program – 8, Result – 2)

Group – B

B1. Use the *Gauss-Seidel* method (without rearrangement or refinement) to solve the simultaneous equations

$$10x_1 - 2x_2 - x_3 - x_4 = 3$$
$$-2x_1 + 10x_2 - x_3 - x_4 = 15$$
$$-x_1 - x_2 + 10x_3 - 2x_4 = 27$$
$$-x_1 - x_2 - 2x_3 + 10x_4 = -9$$

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B2. Find the value of $f(x)$ for $x = 3.5$ using *Lagrange's interpolation formula* using all the data.

x	1.3	2.7	3.5	3.9	4.4
$f(x)$	3.901	60.759	166.763	171.747	231.92

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B3. Using the following data, calculate the values of m and c for *least square fit* to a straight line $y = mx + c$.

x	1	2	3	4	5	6
$f(x)$	–2.95	–1.15	0.90	3.15	4.95	7.05

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B4. Using the following data, calculate the values of m and c for *least square fit* to a straight line $y = mx + c$:

x	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
y	– 1.26	– 1.10	– 0.91	– 0.67	– 0.54	– 0.32	– 0.10	0.08	0.33	0.51

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B5. Using the *bisection* method, find the root of the equation

$$x\sin x + (x-2)\cos x = 0$$

that lies in the range $2 < x < 5$, correct up to the third decimal place.

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B6. Using the *Newton-Raphson* method, find the root of the equation

$$(1-x^2)\tan x - x = 0$$

that lies in the range $2 < x < 3$, correct up to the third decimal place.

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B7. Using *trapezoidal* rule, calculate

$$\int_0^1 \sqrt{1-x^2}\,dx$$

correct upto 3 decimal places.

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B8. Using *Simpson's one-third rule*, calculate

$$\int_0^3 \frac{x}{1+x^5}\,dx$$

correct up to 3 significant digits.

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

2019

PHYSICS — HONOURS — PRACTICAL

Eighth Paper

(Group – B)

Full Marks : 50

(Under 1+1+1 system)

Date of Examination : 06.03.2019

Programming Language : C or Fortran.

Print the output of your programs at the terminals.

SET – 2

Group – A

A1. Given an integer M (say, 3), find the smallest integer n for which the series

$$1+\frac{1}{2}+\frac{1}{3}+\ldots+\frac{1}{n}$$

is larger than M.

(Flowchart / Algorithm – 2, Program – 8, Result – 2)

A2. Read 10 numbers and write a program to arrange them in descending order. Test your program for the following numbers :

1.2, –2.9, 2.1, 6.9, –9.8, 8.7, 5.1, 1.8, –3.5, –4.7

(Flowchart / Algorithm – 2, Program – 8, Result – 2)

A3. Each term of a sequence $\{a_1, a_2, a_3,\ldots\}$ is generated by taking the sum of the previous three terms. If the first three terms are 0 and 1 and 2, find the ratio a_{n+1} / a_n correct to three decimal places for $n \to \infty$.

(Flowchart / Algorithm – 2, Program – 8, Result – 2)

Please Turn Over

A4. Find the prime numbers less than or equal to 89 and count them.

(Flowchart / Algorithm – 2, Program – 8, Result – 2)

A5. Zeta function is defined as $\zeta(n) = \sum_{k=1}^{\infty} \frac{1}{k^n}$

Given that $\zeta(4) = \pi^4/90$ estimate a value of π correct up to 3 significant digits. How many terms are needed in the series for this?

(Flowchart / Algorithm – 2, Program – 8, Result – 2)

A6. Find the *prime number* lying between 3980 and 3990. (There will be only one such number.)

(Flowchart / Algorithm – 2, Program – 8, Result – 2)

A7. Write a program to calculate Trace(M^2) where

$$M = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 4 & 1 & 2 & 3 \\ 3 & 4 & 1 & 2 \\ 2 & 3 & 4 & 1 \end{pmatrix}$$

(Flowchart / Algorithm – 2, Program – 8, Result – 2)

A8. For

$$M = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 4 & 1 & 2 & 3 \\ 3 & 4 & 1 & 2 \\ 2 & 3 & 4 & 1 \end{pmatrix} \quad \textit{and} \quad V = \begin{pmatrix} 1 \\ -1 \\ 1 \\ -1 \end{pmatrix}$$

calculate $\frac{1}{2}MV + V$.

(Flowchart / Algorithm – 2, Program – 8, Result – 2)

Group – B

B1. Use the *Gauss-Seidel* method (without rearrangement or refinement) to solve the simultaneous equations

$$12x_1 + 3x_2 - 5x_3 = 1$$
$$x_1 + 5x_2 + 3x_3 = 28$$
$$3x_1 + 7x_2 + 13x_3 = 76$$

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B2. Given the data

x	0.1	0.2	0.3	0.45	0.5	0.6
$f(x)$	0.545	0.333	0.275	0.258	0.242	0.235

find the value of $f(x)$ for $x = 0.25$ using *Lagrange's interpolation formula* using all the points.

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B3. Using the following data, calculate the values of m and c for *least square fit* to a straight line of $y = mx + c$.

x	1	2	3	4	5	6	7	8	9	10
y	0.94	0.82	0.72	0.58	0.49	0.32	0.21	0.08	0.04	0.01

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B4. Using the *bisection* method, find the root of the equation

$$(x - 2.1)^{1/4} - (4.1 - x)^{1/3} = 0$$

that lies in the range $2 < x < 4$, correct up to the third decimal place.

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B5. Using the *bisection* method, find the root of the equation

$$\tan x = \frac{x}{1 - x^2}$$

that lies in the range $5 < x < 7$, correct up to three significant digits.

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B6. Using the *Newton-Raphson* method, find the root of the equation

$$e^x + 20x^6 - 25x + 2 = 0$$

that lies in the range $-0.5 < x < 0.5$, correct up to three decimal places, by choosing the initial point suitably.

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B7. Using *trapezoidal* rule, calculate

$$\int_1^{3\pi} \frac{\sin x}{x^2} dx$$

correct up to 3 decimal places.

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B8. Using *Simpson's one-third rule*, calculate

$$\int_0^1 x\sqrt{1-x^2}\, dx$$

correct up to 3 decimal places.

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

2019

PHYSICS — HONOURS — PRACTICAL

Eighth Paper

(Group – B)

Full Marks : 50

(Under 1+1+1 system)

Date of Examination : 07.03.2019

Programming Language : C or Fortran

Print the output of your programs at the terminals.

SET – 3

Group – A

A1. Write a program to find the first 20 prime numbers after 97 and find the average of those prime numbers.

(Flowchart / Algorithm – 2, Program – 8, Result – 2)

A2. Read 11 numbers and write a program to *arrange them in descending order*. Test your program for the following numbers :

3.2, 9.8, –5.4, 1.2, 7.6, –8.7, 4.3, 2.5, –0.3, –5.4, 3.2

(Flowchart / Algorithm – 2, Program – 8, Result – 2)

A3. The series expansion for $\log_e(x)$ in the range $x > 1$ is

$$\log_e(x) = \frac{x-1}{x} + \frac{1}{2}\left(\frac{x-1}{x}\right)^2 + \frac{1}{3}\left(\frac{x-1}{x}\right)^3 + \ldots$$

Evaluate $\log_e(x)$ for $x = \pi$ up to three decimal places by using this expansion.

(Flowchart / Algorithm – 2, Program – 8, Result – 2)

Please Turn Over

A4. Calculate log(100!) by using the relation

$$\log(n!) = \sum_{i=2}^{n} \log(i)$$

Also print the value obtained from Stirling's approximation

$$\log n! = n\log(n) - n$$

(Flowchart / Algorithm – 2, Program – 8, Result – 2)

A5. Write down a program to find all the *factors* of a given integer N. Check your program for $N = 3604$.

(Flowchart / Algorithm – 2, Program – 8, Result – 2)

A6. The matrix elements $A_{m,n}$ of a 3×3 matrix A are given by the formula

$$A_{mn} = \sqrt{\frac{n}{2}}\delta_{m,n-1} + \sqrt{\frac{(n+1)}{2}}\delta_{m,n+1}$$

Generate and print the matrix.

(Flowchart / Algorithm – 2, Program – 8, Result – 2)

A7. Calculate the matrix $A^T B$, where

$$A = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 2 & 3 & 4 & 1 \\ 3 & 4 & 1 & 2 \\ 4 & 1 & 2 & 3 \end{pmatrix}, \quad B = \begin{pmatrix} 1.1 & 1.2 & 1.3 & 1.4 \\ 1.2 & 1.3 & 1.4 & 1.1 \\ 1.3 & 1.4 & 1.1 & 1.2 \\ 1.4 & 1.1 & 1.2 & 1.3 \end{pmatrix}$$

(Flowchart / Algorithm – 2, Program – 8, Result – 2)

A8. Compute and print Trace$(M)I - M + M^T$ where I is the identity matrix and

$$M = \begin{pmatrix} 1 & 3 & 5 \\ 3 & 3 & 9 \\ 11 & 15 & 11 \end{pmatrix}$$

(Flowchart / Algorithm – 2, Program – 8, Result – 2)

Group – B

B1. Use the *Gauss-Seidel* method (without rearrangement or refinement) to solve the simultaneous equations

$$5x+3y+2z=17$$
$$2x+3y-z=5$$
$$x-2y-3z=-12$$

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B2. Find the value of $f(x)$ for $x=3.5$ using Lagrange's interpolation formula using all the data.

x	0.1	0.2	0.3	0.4	0.5	0.6
$f(x)$	0.545	0.331	0.275	0.258	0.240	0.235

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B3. Using the following data, calculate the values of m and c for *least square fit* to a straight line $y=mx+c$:

x	1	2	3	4	5	6	7	8	9	10
y	–0.94	–0.82	–0.72	–0.58	–0.49	–0.32	–0.21	–0.08	0.06	0.20

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B4. Using the *bisection* method, find the root of the equation

$$20-2.5x-0.01x^3=0$$

correct up to 3 significant digits. (This equation has only one root, that lies in the range $0<x<10$.)

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B5. Using the *Newton-Raphson* method, find the root of the equation

$$x^2 \ln x=5.72$$

correct up to the third decimal place.

(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B6. Using the *Newton-Raphson* method, find the root of the equation

$$x^2 - 2\exp(-x) = 0$$

correct up to 3 significant digits. (This equation has only one root, that lies in the range $0 < x < 1$.)
(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B7. Using *trapezoidal* rule, calculate

$$\int_0^{\pi} \sqrt{x} \exp x \, dx$$

correct up to 3 significant digits.
(Flowchart / Algorithm – 4, Program – 10, Result – 4)

B8. Using *Simpson's one-third rule*, calculate

$$\int_0^{\pi} e^{-x^2} \sin x \, dx$$

correct up to 3 significant digits.
(Flowchart / Algorithm – 4, Program – 10, Result – 4)