2016

PHYSICS — HONOURS — PRACTICAL

Eighth Paper

(Group – B)

Full Marks – 50

Each examiner will get the entire set of questions and all other instructions from the Examination Centre

GENERAL INSTRUCTIONS FOR THE EXAMINERS

1. **Card drawing :** Prepare two sets of cards marked 'A' and 'B'. The set A should contain questions of Group A and set B should contain questions of Group B. Card drawing should commence 30 minutes before the start of examination. Each student should draw one card from set A and one from set B. If a student wants to draw more than two times (for any set), then 2 marks will be deducted for each draw after the initial two.

2. **Time limit** : The whole examination must be completed within 3 hours, but there is no time restriction for the individual problems.

3. **Division of Marks :**
   Class Note Book : 10, Viva : 10, Experiment : 30
   Experiment in Group A : 12 (Flow chart/Algorithm - 2, Program - 8, Result - 2)
   Experiment in Group B : 18 (Flow chart/Algorithm - 4, Program - 10, Result - 4)

4. **Examination :**

   (a) Marks under the heads CNB and Viva should be given during the examination.

   (b) An Examination Centre may use either Windows or Linux operating system, but the students who are not familiar with the available OS, must be helped by the examiner for compilation and printing.

   (c) Scripts should contain only the algorithm or flowchart and the calculations required (if any) to write the source code. The hard copy of the source code and of the output are to be attached to the script to be evaluated.

   (d) Students will show the execution of program to the examiner and the examiner will sign the print out of the program along with the result during the examination. Viva-voce will be restricted mainly to the assigned problem but questions on other topics of elementary programming may also be asked.

5. **Submission of scripts :** Examination Centre should save the programs day-wise and roll number-wise. **The soft copy of source codes must be submitted to the co-ordinator along with the scripts.** Examination Centre should also mention the OS and the compiler used for the examination.

6. **Examination of scripts** : Proportional part-marking is recommended.

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

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

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

0 0.1162 0.1342
0.1162 0 0.3687
0.1342 −0.3687 0

0 0.1162 0.1342
0.1162 0 0.35
6

Group B

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

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

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

(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

-0.369957

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

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 $y = mx + c$.

$m = 0.126667$
$c = -1.086667$

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

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

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

3.816

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

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

6.76

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

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

2.499

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

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

0.901

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

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

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

−32.831

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

10. Using *trapezoidal* rule, calculate

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

−0.63293

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

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

0.878

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)

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

$$\int_0^5 e^{-x^3} x^3 dx$$

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 $F_{i+1} = F_i + F_{i-1}$. $(i \geq 2,\ F_2 = 1 \text{ and } F_1 = 1)$. 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)

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)

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)

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

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

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)

Each examiner will get the entire set of questions and all other instructions from the Examination Centre.

GENERAL INSTRUCTIONS FOR THE EXAMINERS

1. **Time of Examination :**

   First half : 11.00 a.m. to 2.00 p.m.

   Second half : 2.00 p.m. to 5 p.m.

2. **Preparation of cards :** The packet of the questions for the particular date must be received from the custody on that date. The packet will be opened around 10.20 a.m. in presence of at least one internal and one external examiner. The examiners present at the time of opening must put their signatures on the packet before opening it.

   The number of printed questions is eight (8) in each group. Examiners are requested to take **two copies** of the question paper, cut each question and put inside 32 envelopes. The colour/types of envelopes for Group A must be different for those of Group B.

   There will be 16 envelopes for group A and 16 envelopes for group B on the table before drawing of the cards.

3. **Card drawing :** Card drawing must be done at least 20 to 15 minutes prior to the examination so that students can start their examination in proper time. The preferable time is

   First half : 10.40 a.m.

   Second half : 1.40 p.m.

   Each student should draw one card from set A and one from set B. If a student wants to draw more than two times (for any set), then 2 marks will be deducted for each draw after the initial two.

   Students must copy the whole questions on the script in presence of the examiners and hand over the questions to them. The set of envelopes will be in custody of the examiners and will be taken out for the card drawing for the students in the second half.

4. **Time limit :** The whole examination must be completed within 3 hours, but there is no time restriction for the individual problems.

Please Turn Over

5. **Division of Marks :** Class Notebook : 10, Viva : 10, Experiment : 30

   Experiment in Group A : 12 (Flowchart/Algorithm – 2, Program – 8, Result – 2)

   Experiment in Group B : 18 (Flowchart/Algorithm – 4, Program – 10, Result – 4)

6. **Examination :**

   (a) Marks under the heads CNB and Viva should be given during the examination.

   (b) An Examination Centre may use either Windows or Linux operating system, but the students who are not familiar with the available OS, must be helped by the examiner for compilation and printing. A set of written instructions should also be available to the examinee in general. In addition, the examination centre must provide the necessary compilers used in Fortran (f 77, f 90, g 77 etc) and C.

   (c) Scripts should contain only the algorithm or flowchart and the calculations required (if any) to write the source code. The hard copy of the source code and of the output are to be attached to the script to be evaluated.

   (d) Students will show the execution of program to the examiner and the examiner will sign the print-out of the program along with the result during the examination. Viva voce examination will be from the assigned problems (3 marks for Group A, 4 marks for Group B) and from other topics of elementary programming and numerical methods as per university syllabus (3 marks).

7. **Name and comment line of the source code :**

   (a) The source code for each program should contain a comment line at the beginning with the following information :

   - Roll No.
   - Group A / Group B
   - Question No.
   - Computer No.

   (b) There will be six batches altogether. Centre will make six folders with batch name and the date like Batch 1_05, Batch 2_05, Batch 3_06, Batch 4_06, Batch 5_07, Batch 6_07.

   Examiners are requested to maintain separate folder against each roll number and keep all the files (mainly source files of each group) of the student within it. Students will be instructed to put the name of the source code file in the following way. Suppose a student of **batch 5** get a **question 6a** from **Group A**, then the file name will be **Batch 5_A_6a.c** or **Batch 5_A_6a.f.**

8. **Submission of scripts :** Examination Centre should save the programs day-wise and roll number-wise. **The soft copy of source codes must be submitted to the co-ordinator along with the scripts.** Examination Centre should also mention the OS and the compiler used for the examination.

9. **Examination of scripts :** Proportional part-marking is recommended. (This will be supplied in due course to the centres.)

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

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

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 $\{a_1, a_2, a_3,...\}$ 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)
