MPH-014

ASSIGNMENT BOOKLET

M.Sc. (Physics) Programme
(MSCPH)

COMPUTATIONAL PHYSICS

Valid from 1st January, 2026 to 31st December, 2026

School of Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068
(2026)

Dear Student,

Please read the section on assignments in the Programme Guide for M.Sc. (Physics). A weightage of 30 per cent, as you are aware, has been earmarked for continuous evaluation, **which would consist of one tutor-marked assignment** for this course. The assignment is in this booklet. The total marks for this assignment is 50, of which 20 marks are needed to pass it.

Instructions for Formatting Your Assignments

Before attempting the assignment please read the following instructions carefully:

1) On top of the first page of your answer sheet, please write the details exactly in the following format:

ENROLMENT NO.: …..……

NAME: ……

ADDRESS: ……

COURSE CODE:……..

COURSE TITLE: ……

ASSIGNMENT CODE: ……..

STUDY CENTRE: …….. **DATE:** …….

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

2) Use only foolscap size writing paper (but not of very thin variety) for writing your answers.

3) Leave 4 cm margin on the left, top and bottom of your answer sheet.

4) Your answers should be precise.

5) **Submit the complete assignment answer sheet within the due date.**

6) The assignment answer sheets are to be submitted to your Study Centre as per the schedule. **Answer sheets received after the due date shall not be accepted. We strongly suggest that you retain a copy of your answer sheets.**

7) This assignment is **valid from 1st January, 2026 to 31st December, 2026**. If you have failed in this assignment or fail to submit it by 31st December, 2026, then you need to get the assignment for the year 2027, and submit it as per the instructions given in the Programme Guide.

8) **You cannot fill the examination form for this course** until you have submitted this assignment. For any queries, please contact: mbnewmai@ignou.ac.in, slamba@ignou.ac.in

We wish you good luck.

Tutor Marked Assignment
COMPUTATIONAL PHYSICS

Course Code: MPH-014
Assignment Code: MPH-014/TMA/2026
Max. Marks: 50

Note: Attempt all questions. The marks for each question are indicated against it.

1. a) Explain round-off error and truncation error, with one example of each.

   b) The series for e^x can be written as:

   $$e^x = 1 + x + \frac{x^2}{2!} + \frac{x3}{3!} + ...$$

   Calculate the truncation error when the first four terms of the series are used to evaluate $e^{1.5}$.

   c) Explain why a polynomial is a useful choice for an interpolating function. (4+4+2)

2. a) Use the Secant method with initial guesses of x_0=1 and x_1=2 to calculate the root/s of the equation $f(x) = x^3 - x - 1$ up to three iterations. Calculate the absolute relative approximate error at each stage.

   b) What are the advantages and drawbacks of the Secant method when compared to the Bisection Method and the Newton-Raphson Method? (6+4)

3. a) A population of single-celled organisms was grown in a Petri dish over a period of 24 hours. The number of organisms at a given time is recorded in the table below. Fit the data in the table below to an exponential model $y = \alpha \exp(\beta x)$:

x (time in hours)	0	4	8	12	16	20	24
y	25	36	52	68	85	104	142

   b) Calculate the first derivative of the function $f(x) = \sin(2x)$ at $x = \pi/3$ using the forward divided difference, backward divided difference and central divided difference methods with a step size of h = 0.1 rad. Also calculate the absolute true error in each case. (5+5)

4. a) Evaluate the integral $\int_1^2 x^3 \ln x \, dx$ using the 2-point Gaussian Quadrature Rule with the following values:

Points	**Weights (C_i)**	**Arguments (x_i)**
1	1.0	0. 577
2	1.0	– 0.577

b) Derive the Runge-Kutta 2nd Order formula for the differential equation:

$$\frac{dy}{dx} + y = \exp(-x)$$

Use this to determine the value of y at $x = 2$ given that $y(x = 0) = 2$, using a step size $h = 1.0$. (5+5)

5. a) Using the linear congruential random number generator determine the first five random numbers given that: x_0 = 27, a = 17, c = 43, and m = 100. Transform these random numbers to lie between 0 and 1. What would be the maximum possible period of this random number sequence?

b) Use the LU decomposition method to solve the following system of equations:

$$2x_1 + x_2 - x_3 = 2;$$

$$x_1 + 2x_2 + x_3 = 8;$$

$$-x_1 + x_2 - x_3 = -5.$$ (5+5)

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