

**ASSIGNMENT BOOKLET
Bachelor's Degree Programme**

MATHEMATICAL METHODS IN PHYSICS-I

Valid from January 1, 2026 to December 31, 2026

**It is compulsory to submit the Assignment before filling in the
Term-End Examination Form.**

Please Note

- You can take electives (56 to 64 credits) from a minimum of TWO and a maximum of FOUR science disciplines, viz. Physics, Chemistry, Life Sciences and Mathematics.
- You can opt for elective courses worth a MINIMUM OF 8 CREDITS and a MAXIMUM OF 48 CREDITS from any of these four disciplines.
- At least 25% of the total credits that you register for in the elective courses from Life Sciences, Chemistry and Physics disciplines must be from the laboratory courses. For example, if you opt for a total of 64 credits of electives in these 3 disciplines, at least 16 credits should be from lab courses.
- You cannot appear in the Term-End Examination of any course without registering for the course. Otherwise, your result will not be declared and the onus will be on you.



**School of Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068**

Dear Student,

We hope you are familiar with the system of evaluation to be followed for the Bachelor's Degree Programme. At this stage you may probably like to re-read the section on assignments in the Programme Guide for Elective Courses that we sent you after your enrolment. 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.

Instructions for Formatting Your Assignments

Before attempting the assignment please read the following instructions carefully.

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

ENROLMENT NO. :

NAME :

ADDRESS :

.....

.....

COURSE CODE :

COURSE TITLE :

ASSIGNMENT NO. :

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) While solving problems, clearly indicate the question number along with the part being solved. Be precise. Write units at each step of your calculations as done in the text because marks will be deducted for such mistakes. Take care of significant digits in your work. Recheck your work before submitting it.
- 6) **This assignment will remain valid from January 1, 2026 to December 31, 2026.** However, you are advised to submit it within **12 weeks** of receiving this booklet to accomplish its purpose as a teaching-tool.

We strongly feel that you should retain a copy of your assignment response to avoid any unforeseen situation and append, if possible, a photocopy of this booklet with your response.

We wish you good luck.

Tutor Marked Assignment Mathematical Methods in Physics-I

Course Code: BPHE-104/PHE-04
Assignment Code: BPHE-104/PHE-04/TMA/2026
Max. Marks: 100

Note: Attempt all questions. Symbols have their usual meanings. The marks for each question are indicated against it.

1. a) Find two unit vectors perpendicular to both $\vec{A} = \hat{i} - 2\hat{j} + 3\hat{k}$ and $\vec{B} = -2\hat{i} + 4\hat{j}$. (5)

b) For the vectors \vec{a} , \vec{b} , \vec{c} and \vec{d} show that:

$$(\vec{a} \times \vec{b}) \cdot (\vec{c} \times \vec{d}) + (\vec{b} \times \vec{c}) \cdot (\vec{a} \times \vec{d}) + (\vec{c} \times \vec{a}) \cdot (\vec{b} \times \vec{d}) = 0 \quad (5)$$

2. a) For the vectors $\vec{a} = xyz\hat{i} - 2xz^2\hat{j} + xz\hat{k}$ and $\vec{b} = 2z\hat{i} + y\hat{j} - x\hat{k}$ find

$$\frac{\partial^2}{\partial x \partial y} (\vec{a} \times \vec{b}) \text{ at } (2, 0, -1). \quad (5)$$

b) Show that $(\vec{v} \cdot \nabla) \vec{v} = \frac{1}{2} \nabla v^2 - \vec{v} \times (\nabla \times \vec{v})$. (5)

3. a) Given that $\nabla f(x, y, z) = 2xyz^3\hat{i} + x^2z^3\hat{j} + 3x^2yz^2\hat{k}$ and $f(1, -2, 2) = 4$ show that $f(x, y, z) = x^2yz^3 + 20$. (5)

b) Evaluate $\nabla \times \vec{r} / r^2$. (5)

4. a) Obtain the gradient of the following scalar field :

$$U(\rho, \varphi, z) = \rho^2 z \cos 2\varphi \quad (5)$$

b) Obtain the curl of the following vector field:

$$\vec{A} = (\hat{e}_r + r \cos \theta \hat{e}_\theta + r \hat{e}_\phi) \quad (5)$$

5. a) Find the direction in which the function $f = x^2 - y^2 + 2xy$ decreases most rapidly at the point(1, 1). (5)

b) A plane sheet of material is bound by the curve $y = x^2$ from $x = 0$ to $x = 1$, the x -axis and the line $x = 1$. If the mass per unit area (density) of the sheet is xy find the mass of the sheet. (5)

6. Is the force field defined by $\vec{F} = (3x^2yz - 3y)\hat{i} + (x^3z - 3x)\hat{j} + (x^3y + 2z)\hat{k}$ conservative? If so, find the scalar potential associated with \vec{F} . (10)

7. Evaluate $\iint \vec{A} \cdot \hat{n} dS$, where $\vec{A} = x \cos^2 y \hat{i} + xz \hat{j} + z \sin^2 y \hat{k}$, over the surface of a sphere with its centre at the origin and radius of 4 units. (10)

8. a) Let two dice be thrown. What is the probability that the sum on the dice is greater than or equal to 9? (5)

b) The lifetime X of a bulb is a random variable with the probability density function:

$$f(x) = \begin{cases} 6[0.25 - (x - 1.5)^2] & \text{when } 1 \leq x \leq 2 \\ 0 & \text{otherwise} \end{cases}$$

X is measured in multiples of 1000 hrs. What is the probability that none of the three bulbs in a traffic signal have to be replaced in the first 1500 hrs of their operation. (5)

9. a) Obtain the mean and variance of the discrete random variable X having the probability density function $f(x) = 2x$ for $0 \leq x \leq 1$ and 0 otherwise. (5)

b) If 500 people each select a number a random between 1 and 100, what is the probability that 4 people select the number 25? (5)

10. The number of revolutions per minute (x) and power (y) hp of a diesel engine are tabulated below.

x	400	500	600	700	750
y	580	1030	1420	1880	2100

Obtain the regression equation for this data. (10)

TENTATIVE SCHEDULE FOR PHYSICS PROGRAMMES BROADCAST ON GYAN DARSHAN 1

January 2014 – December 2014

This is the tentative schedule for Physics students. The students may approach their cable operator to avail this facility.

Date/Day	Time Slot	Course Code	Video Programme Title
January 2014			
05-01-14 (Sun)	9.00–9.30 pm	PHE-15	Glimpses of the Cosmos
12-01-14 (Sun)	9.00–9.30 pm	PHE-02	Simple Harmonic Motion
19-01-14 (Sun)	9.00–9.30 pm	PHE-15	Exploring the Night Sky
21-01-14 (Tues)	8.30-9.00 am	PHE-02	Dolan
February 2014			
02-02-14 (Sun)	9.00–9.30 pm	PHE-15	On the Trail of Stars
04-02-14 (Tues)	8.30-9.00 am	PHE-06	Second Law of Thermodynamics
11-02-14 (Tues)	8.30-9.00 am	PHE-02	Coupled Oscillations
March 2014			
04-03-14 (Tues)	8.30-9.00 am	PHE- 13	Introduction to Crystal Structure
11-03-14 (Tues)	8.30-9.00 am	PHE- 15	Astronomical Coordinates
16-03-14 (Sun)	9.00–9.30 pm	PHE- 10	Operational Amplifier
18-03-14 (Tues)	8.30-9.00 am	PHE- 06	Carnot Cycle
April 2014			
06-04-14 (Sun)	9-00-9.30 pm	PHE- 15	Astronomical Measurements (Measurement of Distance and Brightness)
13-04-14 (Sun)	9-00-9.30 pm	BPHE- 101	Rotating Frames of Reference
May 2014			
11-05-14 (Sun)	9.00-9.30 pm	PHE -15	Astronomical Measurements (Measurement of Mass, Temperature and Time)
13-05-14 (Tues)	8.30-9.00 am	PHE -10	Logic Gates

Date/Day	Time Slot	Course Code	Video Programme Title
July 2014			
06-07-14 (Sun)	9.00-9.30 pm	PHE-04	Vector Calculus Part-I
08-07-14 (Tues)	8.30-9.00 am	BPHE-101	Exploring Physics: Experiments with Low cost Materials
13-07-14 (Sun)	9.00-9.30 pm	PHE-11	Matter Waves and the Uncertainty Principle
20-07-14 (Sun)	9.00-9.30 pm	PHE-11	Wave Particle Duality
22-07-14 (Tues)	8.30-9.00 am	BPHE-101	The Bicycle: A Vehicle for Teaching Physics
August 2014			
05-08-14 (Tues)	8.30-9.00 am	BPHE- 101	The Physics of Dance
12-08-14 (Tues)	8.30-9.00 am	PHE- 15	The Milky Way
19-08-14 (Tues)	8.30-9.00 am	PHE -04	Vector Calculus Part-II
26-08-14 (Tues)	8.30-9.00 am	PHE- 15	Stellar Spectra and Classification
September 2014			
02-09-14 (Tues)	8.30-9.00 am	PHE- 10	Digital Modulation
07-09-14 (Sun)	9.00-9.30 am	PHE -10	Amplitude Modulation
09-09-14 (Tues)	8.30-9.00 am	PHE- 06	First Law of Thermodynamics
October 2014			
05-10-14 (Sun)	9.00–9.30 pm	PHE-06	Applications of the First Law of Thermodynamics
12-10-14 (Sun)	9.00–9.30 pm	PHE-15	Stellar Structure
November 2014			
09-11-14 (Sun)	9.00–9.30 pm	PHE-10	Transistor Biasing
December 2014			
14-12-14 (Sun)	9.00–9.30 pm	PHE-06	Thermodynamics in Action
16-12-14 (Tues)	8.30-9.00 am	PHE-06	Ushmagatiki ke Anuprayog
23-12-14 (Tues)	8.30-9.00 am	PHE-10	Electronic Devices

TENTATIVE SCHEDULE FOR PHYSICS STUDENTS ON DD1 (National Network)

(January 2014 to November 2014)

Time: 6.00 AM to 6.30 AM

Month/Date*	Course	Topic
January 2014 13-01-14	PHE-13	Introduction to Crystal Structure
February 2014 10-02-14	BPHE-101	Ghurni Nirdesh Tantra (Hindi)
March 2014 10-03-14	PHE-15	The Milky Way
April 2014 14-04-14	PHE-10	Semiconductor Diode
May 2014 12-05-14	PHE-15	On the Trail of Stars
July 2014 14-07-14	PHE-10	Operational Amplifier
August 2014 11-08-14	PHE-02	Coupled Oscillations
September 2014 08-09-14	PHE-10	Transistor Configuration
October 2014 13-10-14	PHE-06	Thermodynamics in Action
November 2014 10-11-14	PHE-15	Exploring the Night Sky

*** Second Monday of every month**