PHE-05

ASSIGNMENT BOOKLET
Bachelor's Degree Programme

MATHEMATICAL METHODS IN PHYSICS-II

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

2026

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 : ……

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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
PHE-05: Mathematical Methods in Physics-II

Course Code: PHE-05
Assignment Code: PHE-05/TMA/2026
Max. Marks: 100

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

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1. a) Solve the following ordinary differential equations:

   (i) $x dx + y dy + 4y^3(x^2 + y^2)dy = 0$

   (ii) $y'' + 4y = 2\cos x \cos 3x$ (5+10)

   b) Solve the initial value problem:

$$\frac{d^2x}{dt^2} - 3\frac{dx}{dt} - 10x = 0, \quad x(0) = 1, \quad \dot{x}(0) = 0 \tag{5}$$

2. A parachutist is falling with a speed of $50\ \text{ms}^{-1}$ when his parachute opens. If the air resistance is $(Mv^2)/25$ where M is the total mass of the man and his parachute, find the speed of the man as a function of time t after the parachute opens. Take $g = 10\ \text{ms}^{-1}$. (10)

3. A cylinder with a diameter 1.0 m is stands in water with its axis vertical. When depressed slightly and released, it oscillates with a time period of 2 s. Determine the mass of the cylinder. (10)

4. Solve the following ODE using the Frobenius method:

$$\frac{d^2y}{dx^2} + \frac{1}{2x}\frac{dy}{dx} + y = 0 \tag{10}$$

5. a) Show that:

$$u = e^{-\omega^2 c^2 t}\sin(\omega x)$$

   is a solution of the one-dimensional heat equation.

   b) Determine all the first and second order partial derivatives for the function:

$$u\ (x,\ y) = x^2 \sin y + y^2 \cos x \tag{10+10}$$

6. The surface of a ball of radius A is kept at a temperature zero. If the initial temperature in the ball is $f(r)$, write down the boundary conditions and show that the temperature in the ball at time t, $u(r, t)$, is the solution to the equation:

$$c^2\left(\frac{\partial^2 u}{\partial r^2} + \frac{2}{r}\frac{\partial u}{\partial r}\right) = \frac{\partial u}{\partial t}$$

(10)

7. Obtain the Fourier series for the following periodic function which has a period of 2π:

$$f(x) = \pi^2 - x^2 \quad \text{for } -\pi < x < \pi \tag{10}$$

8. Determine the deflection $u(x, t)$ of a vibrating string of length L, which has its ends fixed, corresponding to a zero initial velocity and an initial deflection given by the function:

$$\begin{aligned} f(x) &= Ax && 0 \le x \le L/4 \\ &= AL/4 && L/4 \le x \le 3L/4 \\ &= A(L-x) && 3L/4 \le x \le L \end{aligned} \tag{10}$$

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