

ASSIGNMENT BOOKLET
Bachelor's Degree Programme (B.Sc.)

MATHEMATICAL METHODS IN PHYSICS-I

Valid from January 1, 2020 to December 31, 2020

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

Please Note

- You can take electives (56 or 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 out of those 64 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 responsibility will be yours.



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, 2020 to December 31, 2020.** 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/2020
Max. Marks: 100

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

1. a) Calculate the volume of a parallelepiped whose vertices are given by (0,0,0), (2,1,3), (3,2,4) and (4,2,1). (5)

- b) Show that for any two vectors \vec{a} and \vec{b}

$$(\vec{a} \cdot \vec{b})^2 - [(\vec{a} \times \vec{b}) \times \vec{b}] \cdot \vec{a} = a^2 b^2 \quad (5)$$

2. a) For the vectors

$$\vec{A} = 2t^2 \hat{i} + t \hat{j} - 3t \hat{k} \quad \text{and} \quad \vec{B} = (t-1) \hat{i} + -2t \hat{j} + \hat{k} \quad (5)$$

determine $\frac{d}{dt} \left(\vec{A} \times \frac{d\vec{B}}{dt} \right)$.

- 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) Determine whether the following force field \vec{F} is conservative:

$$\vec{F} = x \hat{i} - y \hat{j} + z \hat{k}. \quad (5)$$

- b) Show that

$$\nabla \cdot (r^2 \hat{r}) = 4r$$

where \hat{r} is the unit vector along \vec{r} . (5)

4. a) Obtain the divergence for the vector field:

$$\vec{F} = r \sin \phi \hat{e}_r - \frac{\sin \theta \cos \phi}{r} \hat{e}_\theta + r^2 \hat{e}_\phi \quad (5)$$

- b) A conductor along the z -axis carries a current i . The magnetic vector potential due to this current is

$$\vec{A} = \frac{\mu i}{2\pi} \ln \left(\frac{1}{\rho} \right) \hat{e}_z$$

Using cylindrical coordinates show that the magnetic induction ($\vec{B} = \nabla \times \vec{A}$) is

$$\vec{B} = \left(\frac{\mu i}{2\pi \rho} \right) \hat{e}_\phi \quad (5)$$

5. Determine the work done by a force $\vec{F} = (xy + 3z)\hat{i} + (2y^2 - x^2)\hat{j} + (z - 2y)\hat{k}$ in taking a particle from $x = 0$ to $x = 1$ along a curve defined by the equations:

$$x^2 = 2y; \quad 2x^3 = 3z \quad (10)$$

6. Using Gauss' theorem calculate the flux of the vector field $\vec{A} = x^3\hat{i} + y^3\hat{j} + z^3\hat{k}$ through the surface of a hemisphere of radius A which has the centre of its base at the origin. (10)

7. Use Stokes' theorem to evaluate the integral:

$$\oint_C (x + z)dx + (x - y)dy + xdz$$

where C is an ellipse defined by the following:

$$\frac{x^2}{16} + \frac{y^2}{25} = 1; z = 4 \quad (10)$$

8. Determine the volume of a solid which is below the plane $z = 8 - 2x - 3y$ and above the region R in the xy plane define by: $0 \leq x \leq 2; 0 \leq y \leq 1$. (10)

9. a) In a sample of pistons manufactured in a factory, it is seen that 10% of the pistons are defective. What is the probability that in a batch of 10 pistons no more than two pistons, are defective? (5)

- b) Power cuts in a locality occur according to a Poisson distribution with an average of 5 power cuts every 14 weeks. Calculate the probability that in a particular week there will not be more than one power cut. (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	500	830	1020	1480	1800

Obtain the regression equation for this data. (10)
