MPH-007

ASSIGNMENT BOOKLET

M.Sc. (Physics) Programme
(MSCPH)

CLASSICAL ELECTRODYNAMICS

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 100, of which 40 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 assignment answer sheets 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 December 31, 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 the assignment for the course. For any queries, please contact: srjha@ignou.ac.in; mbnewmai@ignou.ac.in

We wish you good luck.

Tutor Marked Assignment
CLASSICAL ELECTRODYNAMICS

Course Code: MPH-007
Assignment Code: MPH-007/TMA/2026
Max. Marks: 100

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

PART A

1. Write Maxwell's equations in both differential and integral forms. Explain the physical significance of the displacement current in Maxwell's modification of Ampere's law. (3,3,4)

2. Define the Poynting vector. Starting from Maxwell's equations, derive the Poynting theorem and explain its physical interpretation in terms of energy conservation in electromagnetic fields. (2,5,3)

3. Derive the electromagnetic wave equation for $\vec{E}$ and $\vec{B}$ fields in vacuum starting from Maxwell's equations. Discuss the general properties of plane electromagnetic waves, including their speed and polarisation. (3,3,4)

4. Using boundary conditions on the electric and magnetic fields, derive the Fresnel reflection and transmission coefficients for a plane wave incident normally on a boundary between two dielectric media. (10)

5. a) A plane electromagnetic wave of frequency 1 GHz is normally incident on a medium with relative permittivity $\varepsilon_r = 4$. Calculate the wavelength of the wave in the medium. (4)

   b) Show that if the electric field of the incident wave is normal to the plane of incidence, the electric fields of the reflected and transmitted waves are also normal to the plane of incidence. (6)

PART B

6. Describe the principle of guided wave propagation in a rectangular waveguide. Derive the expression for the cut-off frequency of TE_{mn} modes in terms of waveguide dimensions. (10)

7. a) Starting from the scalar and vector potentials, derive the expression for the electromagnetic fields produced by a small oscillating electric dipole. (10)

   b) Obtain the Larmor formula for the total radiated power of a non-relativistic accelerating charge and explain its significance. (5)

8. a) Explain the Lorentz transformation between two inertial frames. Obtain the transformation laws for the electric and magnetic fields. (5,5)

   b) A particle with charge 1 mC moves with velocity $v = 0.8c$ perpendicular to a uniform magnetic field of magnitude 1 mT. Calculate the magnetic force acting on the particle. (5)

9. Write short notes on:

   a) Dispersion of electromagnetic waves in a medium. (5)

   b) Skin depth in conductors and its physical significance. (5)

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