MPH-003

ASSIGNMENT BOOKLET

M.Sc. (Physics) Programme
(MSCPH)

ELECTROMAGNETIC THEORY

Valid from 1st January, 2024 to 31st December, 2024

School of Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068
(2024)

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 2024 to 31st December 2024**. If you have failed in this assignment or fail to submit it by December 31, 2024, then you need to get the assignment for the year 2025, 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: srjha@ignou.ac.in, sgokhale@ignou.ac.in

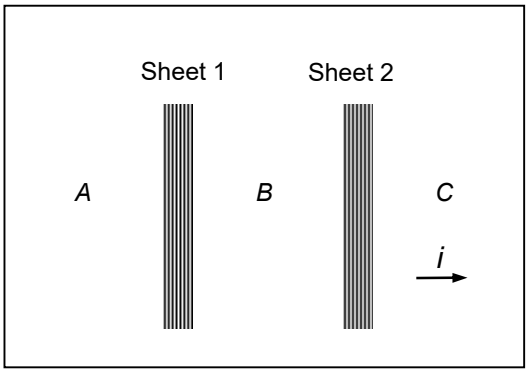
We wish you good luck.

Tutor Marked Assignment
ELECTROMAGNETIC THEORY

Course Code: MPH-003
Assignment Code: MPH-003/TMA/2024
Max. Marks: 50

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

1. Two identical infinite non-conducting sheets having equal positive surface charge densities σ are kept parallel to each other as shown in the Figure below. Determine the electric field at a point in (a) region *A* on the left of the sheet 1, (b) region *B* between the sheets and (iii) region *C* on the right of the sheets.



(5)

2. Obtain the general solution of the two-dimensional Laplace's equation in spherical polar coordinates given by

$$\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial V}{\partial r}\right)+\frac{1}{r^2\sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial V}{\partial\theta}\right)=0 \qquad (10)$$

3. A point charge *Q* is situated at a distance *D* from the centre of an earthed conducting sphere of radius *R* where *D* > *R*. Using the method of images, determine the value and position of image charge and calculate the potential and electric field at a point outside the sphere. (5)

4. Considering a simple physical model of a dielectric as an aggregate of a large number of simple harmonic oscillators, obtain an expression for the dielectric constant. (5)

5. Using the multipole expansion technique, obtain the expression for the magnetic vector potential due to a localized current distribution at a distant point. (5)

6. Calculate the magnetic field inside and outside of a very long solenoid consisting *n* turns per unit length on a cylinder of radius *R* and carrying a steady current *I*. (10)

7. Obtain an expression for torque on a current loop kept in a uniform magnetic field. (5)

8. A toroid has mean circumference 0.4 m and has 600 turns, each carrying a current of 0.12 A. (a) Calculate $\vec{H}$ and $\vec{B}$ if the toroid has an air core. (b) Calculate $\vec{B}$ and the magnetisation $\vec{M}$ if the core is filled with iron of relative permeability 4000. (5)

****