**PHE-07**

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

## ELECTRIC AND MAGNETIC PHENOMENA

**Valid from January 1, 2021 to December 31, 2021**

**It is compulsory to submit the Assignment before filling up 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**

**2021**

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 (TMA)** 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:

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ENROLMENT NO. : ……

NAME : ……

ADDRESS : ……

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COURSE CODE : ……..

COURSE TITLE : ……..…….

ASSIGNMENT NO. : ……..…

STUDY CENTRE : ……..……. DATE : ….……...……

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**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, 2021 to December 31, 2021**. 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.** If you have any problems or queries related to the course, you can write to us on the e-mail **srjha@ignou.ac.in** or **vijayashri@ignou.ac.in**

We wish you good luck.

# Tutor Marked Assignment
# ELECTRIC AND MAGNETIC PHENOMENA

**Course Code: PHE-07**
**Assignment Code: PHE-07/TMA/2021**
**Max. Marks: 100**

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

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1. a) Two positively charged particles each having charge 20 μC, are kept at a distance of 2.0 m from each other. Determine the force on each charge and the electric field due to each charge. Show the force and electric field vectors on appropriate diagrams. What is the resultant force at a point midway from the two charges along the straight line joining them? (2+2+4+2)

   b) What does cylindrically symmetric charge distribution mean? Use Gauss's law to determine the electric field of an infinite solid cylinder of radius *R* having volume charge density ρ at a point outside it. (4+6)

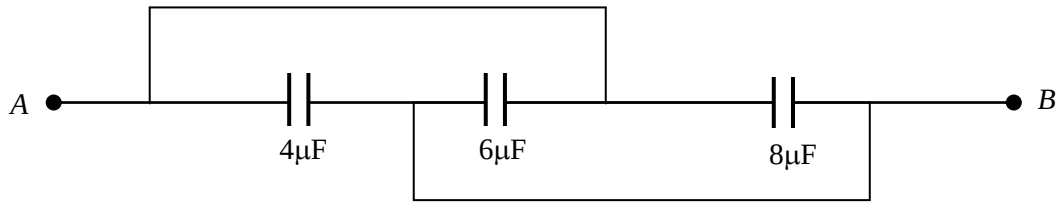
   c) Three charges 2*q*, 4*q* and 2*q* are to be placed on a 1.0 m long straight wire. Determine the positions where the charges should to be placed so that the potential energy of the system is a minimum. (5)

2. a) Discuss the behaviour of a dielectric in an electric field and thereby define molecular polarisability and polarisation. (5+5)

   b) Explain how Gauss's law is modified for dielectric material and establish the relation:

   $$\nabla . \vec{\mathbf{D}} = \rho_f$$ (10)

   c) Three capacitors are connected to each other as shown below:




   Calculate the equivalent capacitance between points *A* and *B*. (5)

3. a) What is a linear conductor? Discuss the conditions under which a metal does not behave as a linear conductor. (5)

   b) The number density of electrons in the aluminium metal is $9.64 \times 10^{28}$ $m^{-3}$. Calculate the drift velocity of electrons in an aluminium wire of cross-sectional area 4.0 $mm^2$ in which a current of 2 A is flowing. (5)

   c) Using Biot-Savart's law, obtain an expression for the magnetic field due to electric current flowing in a long straight wire at a distance *R* from the wire along a line perpendicular to the wire. (10)

   d) Show that in the presence of external magnetic field, the magnetisation of a paramagnetic material depends on the strength of the magnetic field and the temperature of the material. (5)

4. a) Using Maxwell's equations in free space, derive the wave equation for the *y*-component of the electric field vector. (10)

b) A uniform plane electromagnetic wave of 100 MHz travelling in free space strikes a large block of a material having $\varepsilon = 4\ \varepsilon_0$, $\mu = 9\ \mu_0$ and $\sigma = 0$ normal to the surface. The incident electric field vector is given by

$$\mathbf{E} = 500 \cos(\omega t - \beta y)\ \hat{\mathbf{z}}\ \text{Vm}^{-1}$$

Write the complete expressions for the reflected and transmitted electric field vectors, and the incident, reflected and transmitted magnetic field vectors. (3×5)

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