

ASSIGNMENT BOOKLET

Valid from January 1, 2020 to December 31, 2020

It is compulsory to submit your assignment response before filling up 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.**



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 based on Blocks 1 to 4.

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.

We wish you good luck.

Tutor Marked Assignment Electric and Magnetic Phenomena

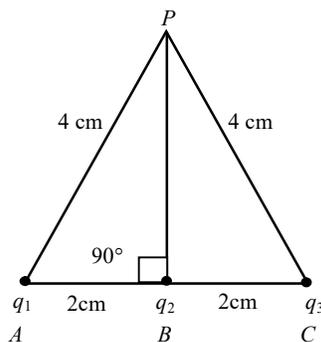
Course Code: PHE-07
Assignment Code: PHE-07/TMA/2020
Max. Marks: 100

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

1. State, **giving reasons**, whether the following statements are **True** or **False**: (10×4=40)

- i) When a comb is run in dry hair, the comb is charged by $+7e$ and the hair by $-5e$.
- ii) An object is enclosed within a metallic spherical shell having surface charge $+q$ C. The object will carry charge $-q$ C.
- iii) The work done in taking a unit charge from one point to another in the electric field of a charge $+Q$ C depends on the path followed by the charge.
- iv) In polar molecules, dipole moment exists even in the absence of an external electric field.
- v) When a dielectric material is inserted between the parallel plates of a capacitor, the electrostatic energy stored between the plates increases.
- vi) An electron moves in a magnetic field of 1T with velocity $5.0 \times 10^5 \text{ ms}^{-1}$ in the direction of the magnetic field. The magnitude of the force experienced by the electron is $9.5 \times 10^{-14} \text{ N}$.
- vii) Gauss's law for magnetism suggests that magnetic monopoles exist.
- viii) Magnetisation of a paramagnetic material attains a saturation value at very low temperatures and high magnetic fields.
- ix) Step-up transformer converts high voltage, low current into low voltage high current.
- x) The electric field associated with a plane electromagnetic wave is given by $\mathbf{E} = 50 \cos(\omega t - 10\pi x) \hat{z} \text{ Vm}^{-1}$. Its wavelength is 0.5 m.

2. Consider the figure given below. Charges q_1, q_2 and q_3 are placed at A, B and C , respectively, and $q_1 = q_2 = -q_3 = 2\mu\text{C}$. Determine the magnitude and the direction of the electric field at point P . (10)



3. a) The capacitance of a parallel plate capacitor is increased by a factor of 7 when a dielectric material fills the space between its plates. What is the relative permittivity of the dielectric material? If this material is placed in between the plates of a cylindrical capacitor of outer and inner radii 12 cm and 10 cm, respectively, calculate the capacitance per unit length of the cylindrical capacitor. (2+3)

- b) A glass of relative permittivity 4 is kept in an external electric field of magnitude 10^2 Vm^{-1} . Calculate the polarisation vector, molecular/atomic polarisability and the refractive index of the glass. (5)
4. a) A copper wire of diameter 1 mm and length 30 m is connected across a battery of 2V. Calculate the current density in the wire and drift velocity of the electrons. The resistivity of copper is $1.72 \times 10^{-8} \Omega\text{m}$ and $n = 8.0 \times 10^{28}$ electrons m^{-3} . (5)
- b) A particle carrying charge q enters a magnetic field \mathbf{B} with velocity \mathbf{v} at an angle $\theta \neq 0 \neq 90^\circ$. Show that it follows a helical path. Determine the radius of the helix. (3+2)
- c) How do we differentiate between diamagnetic and paramagnetic materials? Show that for diamagnetic atoms placed in an external magnetic field \mathbf{B} , the change in dipole moment is opposite to the direction of \mathbf{B} . (2+3)
- d) Why do magnetic moments in ferromagnetic materials, tend to align parallel to each other? Establish the relation $\mathbf{B} = \mu_0 (\mathbf{H} + \mathbf{M})$, for a ferromagnetic material. (2+3)
5. a) Derive the wave equation for the z -component of the electric field of an electromagnetic wave and show that the wave propagates in free space with the speed of light $c = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$. (10)
- b) A sinusoidal plane electromagnetic wave propagates from water ($n_w = 1.33$) to glass ($n_g = 1.5$). Calculate the reflection and transmission coefficients for this wave at the interface of the two media. Show that when an electromagnetic wave enters from one dielectric medium to the other, its frequency remains unchanged. (5+5)