

FOURTH SEMESTER B.Sc. DEGREE (SUPPLEMENTARY/IMPROVEMENT)
EXAMINATION, MAY 2016

Core Course—Physics

PH 4B 07—ELECTRODYNAMICS—I

Time : Three Hours

Maximum : 30 Weightage

The symbols used in this question paper have their usual meanings.

Section A

I. Objective type questions. Each question carries a weightage of $\frac{1}{4}$.

Choose the correct alternative from the given list :

1. $\text{div Curl } \mathbf{E} = \text{_____}$.

- (a) Zero. (b) $\nabla^2 B$.
(c) Infinity. (d) None above.

2. The Displacement vector $\mathbf{D} =$

- (a) $\epsilon_0 \mathbf{E} + \mathbf{P}$. (b) $\epsilon_0 \chi_e \mathbf{E}$.
(c) $\epsilon_0 \partial \mathbf{E} / \partial t$. (d) $1 + \chi_e$.

3. $\nabla \cdot \mathbf{B} = 0$ implies.

- (a) \mathbf{B} is always zero. (b) \mathbf{B} is a constant.
(c) \mathbf{B} is irrotational. (d) \mathbf{B} is solenoidal.

4. The magnetic susceptibility of a diamagnetic material is :

- (a) Zero. (b) Less than zero.
(c) Greater than zero. (d) Complex.

Fill in the blanks :

5. The value of permittivity of air is _____.
6. The general solution of one dimensional Laplace's equation is a _____.
7. The equation connecting Polarization and susceptibility is _____.
8. The field outside a current carrying solenoid is _____.

Turn over

Give very brief answers :

- 9 Write down the expression for flux of a vector.
- 10 Give differential form of Ampere's law.
- 11 Name the force experienced by a moving charge due to a magnetic field.
- 12 Give an example for a ferromagnetic material.

(12 × ¼ = 3 weightage)

Section B

II. Answer all *nine* questions. Each question carries a weightage of 1 :

- 13 What is a Gaussian surface ?
- 14 Show that electric potential obeys superposition principle.
- 15 State 2nd Uniqueness theorem.
- 16 Define a linear Dielectric. Give an example.
- 17 What are the boundary conditions for **D**.
- 18 When a bar magnet is broken into 2 equal parts each part becomes a new magnet. Explain it on the basis of vanishing divergence of **B**.
- 19 What is Physical significance of the equation $\nabla \times \mathbf{E} = 0$.
- 20 Define magnetization .What is its unit ?
- 21 How is Magnetic susceptibility related to permeability ?

(9 × 1 = 9 weightage)

Section C

III. Answer any *five* questions. Each question carries a weightage of 2 :

- 22 Find the electric field due to a uniformly charged solid cylinder both inside and outside the Cylinder.
- 23 Derive the equation for the capacitance of a Spherical capacitor.
- 24 A point charge q is situated at a distance r from the centre of a grounded conducting sphere of radius R . Find the potential inside and outside the sphere using the method of images
- 25 Find the minimum kinetic energy of a proton which would encircle the earth along the equator. Assume the radius of earth = 6,400 km and $B_H = 4 \times 10^{-5}$ Tesla
 $m_p = 1.7 \times 10^{-27}$ kg.
- 26 Find the magnetic flux density of a square wire loop of side 10 cm, carrying 1 Amp at its centre
- 27 Explain how the concept of vector potential is introduced in magnetostatics. What is its advantage ?
- 28 Derive the equation of field due to a magnetised object.

(5 × 2 = 10 weightage)

Section D

IV. Answer any *two* questions. Each question carries a weightage of 4 :

- 29 Derive an expression for energy of a charged capacitor. Show that the dielectric in between the plates of a parallel plate capacitor experiences a force and derive an equation for it.
- 30 Define the terms 'boundary condition'. Derive boundary conditions in magneto statics and compare them with electrostatic boundary conditions.
- 31 Derive Clausius-Mossotti equation.

(2 × 4 = 8 weightage)