G-2/239/21

Roll No. .....

M.Sc. II Semester Examination, 2021

PHYSICS

Paper I

(Electrodynamics)

Time : 3 Hours] [Max. Marks : 80

Note : *All questions are compulsory. Question Paper comprises of 3 sections. Section A is objective type/multiple choice questions with no internal choice. Section B is short answer type with internal choice. Section C is long answer type with internal choice.*

SECTION A **1 × 8 = 8**

(Objective Type Questions)

Choose the correct answer :

1. The electric field inside a conducting material of radius R is :

(a) $\frac{9}{4\pi\varepsilon_0 r^2}$ (b) Zero

(c) $\frac{9}{4\pi\varepsilon_0 R^2}$ (d) None of these.

2. In terms of electromagnetic potentials (A and ϕ), the field vector $\bar{E}$ and $\bar{B}$ are given by :

(a) $\bar{B} = \text{curl}\,\bar{A}$ and $\bar{E} = \text{grad}\,\phi - \frac{\partial \bar{A}}{\partial t}$

(b) $\bar{B} = \text{curl}\,\bar{A}$ and $\bar{E} = -\text{grad}\,\phi + \frac{\partial \bar{A}}{\partial t}$

(c) $\bar{B} = \text{curl}\,\bar{A}$ and $\bar{E} = \text{grad}\,\phi + \frac{\partial \bar{A}}{\partial t}$

(d) $\bar{B} = \text{curl}\,\bar{A}$ and $\bar{E} = -\text{grad}\,\phi - \frac{\partial \bar{A}}{\partial t}$.

3. The energy per unit time, per unit area, transported by the electromagnetic fields is expressed as :

(a) $\bar{S} = \left(\frac{1}{\mu_2}\right)(\bar{E} \times \bar{B})$ (b) $\bar{S} = (\bar{E} \times \bar{B})$

(c) $\bar{S} = \mu_0(\bar{E} \times \bar{B})$ (d) $\bar{S} = \frac{1}{\varepsilon_0}(\bar{E} \times \bar{B})$.

4. The Maxwell's equation which remains unchanged when a medium changes is :

(a) $\bar{\nabla}.\bar{B} = 0$ (b) $\bar{\nabla}.\bar{B} = \frac{\rho}{\varepsilon_0}$

(c) $\bar{\nabla}.\bar{B} = \mu_0\bar{J} + \mu_0\varepsilon_0\frac{\partial \bar{E}}{\partial t}$ (d) None of these.

5. The total energy stored in electromagnetic field is :

(a) $\frac{\varepsilon_0}{2}\int E^2 dv$ (b) $\frac{1}{2\mu_0}\int E^2 dv$

(c) $\frac{1}{2}\int\left[\varepsilon_0 E^2 + \left(\frac{1}{\mu_0}\right)B^2\right]dv$

(d) $\frac{\varepsilon_0\mu_0}{2}\int E^2 B^2 dv$

6. When angle of incidence is greater than Brewster's angle, the reflected ray suffers a phase change of :

(a) π (b) $\frac{\pi}{2}$

(c) 0 (d) 2π.

7. For good conductors, skin depth varies inversely with ..... power of frequency.

(a) One (b) Two

(c) Half (d) Three.

8. The potential which exhibit the dependence of the potential on the velocity of the particle is known as :

(a) Scalar Potential (b) Vector Potential

(c) Lienard – Wiechert Potential

(d) Retarded Potential.

SECTION B **6×4=24**

(Short Answer Type Questions)

Note : *Attempt one question from each unit.*

Unit-I

1. What is equation of continuity ? Derive it. Write down Maxwell's equation in differential and integral form both ?

Or

Explain mathematically plane e.m. waves in free space .

Unit-II

2. Explain boundary conditions at the interface of two media.

Or

How the experimental verification of Fresnel's equations can be done ?

Unit-III

3. Write down postulates of Einstein's special theory of relativity ? Also explain Gallilean transformation.

Or

Explain Transformation of differentail operator and invariance of D'Alembertian operator.

Unit-IV

4. Explain Lorentz Gange.

Or

Derive Abrahm-Lorentz formula.

SECTION C **12×4=48**

(Long Answer Type Questions)

Note : *Attempt one question from each unit.*

Unit-I

1. Derive Maxwell's equations in some particular cases :

(a) In free space,

(b) In linear isotropic medium.

Or

Describe mathematically propagation of e.m. waves in ionized gases.

Unit-II

2. Derive Fresnel's equations in following cases :

Case I : E-vector is perpendicular to plane of incidence.

Case II : E-vector is parallel to plane of incidence.

Or

Explain wave gride : TM and TE modes.

Unit-III

3. Explain Lorentz transformation and its consequences : Length contraction, Time dilation and Velocity addition.

Or

Explain transformation of electromagnetic potentials A and ϕ. Also write down Lorentz condition in covarient form.

Unit-IV

4. Explain mathematically Lienard-Wiechart potentials.

Or

Explain radiation from a linear Half-Wave antenna.

★ ★ ★ ★ ★ c ★ ★ ★ ★ ★