

PE-260-CV-19
M.Sc. PHYSICS (2nd Semester)
Examination, June 2022
ELECTRODYNAMICS

Time : Three Hours]

[Maximum Marks : 80
[Minimum Pass Marks : 29

Note : Answer from both the Sections as directed. The figures in the right-hand margin indicate marks.

Section-A

1. Answer the following short answer questions: 1x10=10
- (a) Which quantity is related to the flow of electromagnetic energy?
 - (b) What is the relation between electromagnetic energy density and energy flux?
 - (c) Write the differential form of modified Ampere's law.
 - (d) State the properties of electromagnetic waves in isotropic dielectric medium.
 - (e) The failure to find the magnetic monopole can be stated mathematically by.....
 - (f) State the Brewster's law mathematically.
 - (g) Write the Lorentz condition in covariant form.
 - (h) Write the equation of continuity in covariant form.
 - (i) Express the magnetic flux through an area in terms of the vector potential around the closed curve bounding the area.
 - (j) Write the retarded solution for vector potential.
2. Answer the following short type questions: 2x5=10
- (a) Calculate the reflectance and transmittance when light travels in air falls normally on a glass surface ($n=1.5$).
 - (b) Show that $\square'$ Alembertian operator is invariant under Lorentz transformation.
 - (c) Show that charge is invariant quantity under Lorentz transformation.
 - (d) Write the postulates of special theory of relativity.
 - (e) What are Gauge transformations?

Section-B

15x4=60

Answer the following Long-Answer questions:

3. State the Poynting's theorem for conservation of electromagnetic energy of charged particles and fields. Also deduce the differential and integral form of Poynting's theorem.

OR

Discuss the propagation of electromagnetic waves in an anisotropic dielectric medium and find solution to the wave equations.

4. a). Obtain the boundary conditions satisfied by the field vectors $\vec{E}$, $\vec{D}$, $\vec{B}$ and $\vec{H}$ on the plane interface between two media. 7
- b). A plane wave travelling in a homogeneous isotropic dielectric is incident obliquely at the plane interface of another dielectric. Determine the reflection and transmission coefficient if the incident wave is polarized with its electric field vector. 8

OR

What is a wave-guide? For transverse electric waves perfectly propagating in a rectangular wave guide with perfectly conducting walls, find-

- a). The cutoff wavelength
- b). Magnetic field induction

5. a). Show that $x^2 + y^2 + z^2 - c^2 t^2$ is invariant under Lorentz transformation. 8
b). Prove that the three dimensional volume element dx, dy, dz is not invariant but 7
four dimensional volume element is invariant under Lorentz transformation.

OR

Define the electromagnetic field tensor $F_{\mu\nu}$. Using this tensor, express the Maxwell's equations in covariant form.

6. Express the Maxwell's equations in terms of electromagnetic vector and scalar potentials. Use Gauge transformations to obtain separate wave equations for electromagnetic vector and scalar potentials. Define Lorentz gauge.

OR

What are Lienard-Wiechart potentials? Calculate the electric and magnetic field vector for a uniformly moving point charge using this potential. Discuss the results obtained.