



QP CODE: 25050516



25050516

Reg No :

Name :

MSc DEGREE (CSS) EXAMINATION DECEMBER 2025

First Semester

Core Courses - PH010103 - ELECTRODYNAMICS

M Sc PHYSICS, MSc SPACE SCIENCE.

2019 Admission Onwards

D1A47674

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

Answer any **eight** questions.

Weight 1 each.

1. Bring out the expression for induced surface charge when a point charge is placed at a distance d from an infinite grounded conducting sheet.
2. Write down the multipole expansion for the potential of an arbitrary localized charge distribution.
3. What is Maxwell's stress tensor?
4. Sketch the directions of incident, reflected and transmitted electric and magnetic fields of a monochromatic wave on the boundary separating two linear media at an arbitrary incident angle θ_I traveling in the $\hat{k}$ direction polarised in the $\mathbf{x}$ direction.
5. Write expressions for the electric and magnetic fields in terms of the scalar and vector potentials in static and dynamic charge/current distributions.
6. Indicate whether the following statement is true or false: *A charged sphere whose radius oscillates in and out would radiate.* Justify your answer in a sentence or two.
7. What is radiation reaction?
8. Explain space like, time like and light like intervals.
9. Express Minkowski force in tensor notation and evaluate its components.
10. Express Maxwell's equations in a single equation using the four vector potential.

(8×1=8 weightage)

Part B (Short Essay/Problems)

Answer any **six** questions.

Weight 2 each.

11. What current density would produce the vector potential $\vec{A} = k\hat{\phi}$, where k is a constant, in cylindrical coordinates?





12. A long cylinder of radius R carries a magnetisation $\vec{M} = ks\hat{z}$, where k is a constant and s is the distance from the axis. Find the bound currents and magnetic fields they produce for points inside and outside the cylinder.
13. The intensity of sunlight hitting the surface of earth is about 1300W/m^2 . Find the amplitude of electric and magnetic fields.
14. Show that for plasma, frequencies greater than plasma frequency, the EM waves propagate without attenuation.
15. Show that the retarded potentials satisfy the Lorentz gauge condition.
16. Calculate $\frac{\partial A}{\partial t}$ for the Lienard-Wiechert potentials of a moving point charge.
17. Calculate $\eta^\mu \eta_\mu$, where η^μ is the four velocity vector. How does this quantity transform under Lorentz transformation.
18. A rectangular wave guide has $a=5\text{cm}$. and $b=4\text{cm}$. Find the lowest cut-off frequency.

(6×2=12 weightage)

Part C (Essay Type Questions)

Answer any **two** questions.

Weight **5** each.

19. Explain the concept of polarisation. What are bound charges ? Explain its physical significance.
20. Discuss the nature of wave vector $\hat{k}$ in a conducting medium and show that the magnetic field inside a conductor lags behind the electric field?
21. Show that the power radiated by an oscillating electric dipole of angular frequency ω is proportional to ω^4 .
22. Consider transformation of electromagnetic fields under Lorentz transformation and obtain transformation equations.

(2×5=10 weightage)

