



LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – PHYSICS

FIRST SEMESTER – APRIL 2016

PH 1818 - ELECTRODYNAMICS

Date: 28-04-2016
Time: 01:00-04:00

Dept. No.

Max. : 100 Marks

PART – A

Answer **ALL** questions:

(10x2=20)

1. Obtain the differential form of Gauss's law from the integral form.
2. For volume currents, show that $\nabla \cdot \mathbf{B} = 0$.
3. State Poynting's theorem.
4. What is a gauge transformation? Give an example.
5. What do you mean by time like interval?
6. A muon is travelling through the laboratory at three-fifths the speed of light. How long does it last?
7. Write down the Lorentz transformation of a four vector.
8. Write down the relativistic Lagrangian for a free particle.
9. What are the boundary conditions on \mathbf{E} and \mathbf{B} for a wave guide?
10. Why TEM mode is not possible in a hollow waveguide?

PART – B

Answer any **FOUR** questions:

(4 x7.5=30)

11. Find the general solution to Laplace's equation in spherical coordinates when V depends only on r . Also obtain the general solution to Laplace's equation in cylindrical coordinates when V depends only on s .
12. Derive expressions for energy density and momentum of electromagnetic waves.
13. Arrive at an expression for the proper velocity four vector and hence establish its transformation equations.
14. Find the retarded potentials $V(\mathbf{r}, t)$ and $\mathbf{A}(\mathbf{r}, t)$ of a point charge moving with constant velocity.
15. Explain how a coaxial transmission line supports propagation of TEM waves.
16. Combine the electric and magnetic field in to a single entity the Field tensor $F^{\mu\nu}$.

PART – C

Answer any **FOUR** questions:

(4 x12.5=50)

17. Outline the theory of multipole expansion of electrostatic potential in powers of $(1/r)$.
18. Establish Maxwell's equations in matter.
19. Obtain the transformation equations among the components of electric and magnetic fields.
20. Obtain Leinard -Wiechert potentials for a moving point charge.
21. What are waveguides? Obtain expressions for the longitudinal components E_z and B_z .
22. Prove the uniqueness theorems in electrostatics.
