



LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – PHYSICS

FIRST SEMESTER – APRIL 2018

17PPH1MC02/PH 1818- ELECTRODYNAMICS

Date: 02-05-2018
Time: 01:00-04:00

Dept. No.

Max. : 100 Marks

PART A

Answer **ALL** questions:

(10 x 2 = 20)

1. Establish Ampere's law in differential and integral form.
2. Show that the electrostatic potential satisfies superposition principle.
3. State Poynting's theorem.
4. What is a gauge transformation? Give an example.
5. Define skin depth.
6. State the Einstein velocity addition rule.
7. Define radiation zone.
8. Give the Larmor formula for power radiated by a point charge.
9. What is cut-off frequency with reference to a waveguide?
10. Find the cut-off frequency for a given wave guide in the TE_{10} mode.

PART B

Answer any **FOUR** questions:

(4 x 7.5 = 30)

11. A long cylinder carries a charge density that is proportional to the distance from the axis $\rho = ks$ for some constant k . Find the electric field inside the cylinder.
12. Derive expressions for energy and momentum of electromagnetic waves.
13. A pion at rest decays into a muon and a neutrino. Find the energy of the outgoing muon in terms of the two masses, m_π and m_μ (assume $mv=0$). Also find the velocity of the outgoing muon.
14. An infinite straight wire carries a current $I(t) = 0$ (for $t \leq 0$) and $I(t) = I_0$ (for $t > 0$). Find the resulting electric and magnetic fields.
15. Consider a rectangular wave guide with dimensions 2.28 cm x 1.01 cm. What TE modes will propagate in this wave guide, if the driving frequency is 1.70×10^{10} Hz?
16. Why TEM mode is not possible in a hollow waveguide? Show that a coaxial transmission line support TEM waves.

PART C

Answer any **FOUR** questions:

(4x12.5=50)

17. Derive the expression for multipole expansion of vector potential.
18. Derive Fresnel's equation for reflection and transmission at oblique incidence.
19. Give the complete set of transformation equations among the components of electric and magnetic fields. Show that $\mathbf{E} \cdot \mathbf{B}$ is Lorentz invariant.
20. Obtain Leinard-Wiechert potentials for a moving point charge.
21. What are waveguides? Obtain the general expressions for the longitudinal components E_z and B_z .
22. Derive an expression for the power radiated by an oscillating point charge.
