LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **PHYSICS**

FIRST SEMESTER – **APRIL 2019**

17/18PPH1MC02– ELECTRODYNAMICS

Date: 08-04-2019 Dept. No. Max. : 100 Marks

Time: 01:00-04:00

PART - A

Answer **ALL** questions **(10×2=20)**

1. An infinite conducting plane carries a uniform surface charge σ. Find its electric field.
2. Show that the electric potential obeys the superposition principle.
3. A cylindrical resistor of cross-sectional area A and length L is made from material with conductivity σ. If the potential difference between the ends is V, find the current flowing through it.
4. State Poynting's theorem.
5. What do you mean by time like interval?
6. Two lumps of clay, each of rest mass (m), collide head-on at $\frac{3}{5}$ c.If they stick together, what is the mass (M) of the composite lump?
7. Calculate the radiation damping of a charged particle attached to a spring of natural frequency ω_0 driven at frequency ω.
8. The plates of a parallel plate capacitor move close by an infinitesimal distance S. Find the work done by electrostatic forces in terms of the field E.
9. What are the boundary conditions on **E** and **B** for a wave guide?
10. Find the cut-off frequency for a given wave guide in the mode $TE_{10.}$

PART - B

Answer any **FOUR** questions **(4×7.5=30)**

11. Derive the cyclotron formula. A particle of charge q enters a region of uniform magnetic field B. The field deflects the particle a distance 'd' above to original line of flight. Find the momentum of the particle. **(3 + 4.5 marks)**
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 m_v=0). Also find the velocity of the outgoing muon.
14. Find the retarded potentials V(**r**, t) and **A**(**r**, t) of a point charge moving with constant velocity.
15. Consider a rectangular wave guide with dimensions 2.28cm x 1.01cm. What TE modes will propagate in this wave guide, if the driving frequency is 1.70×10^{10} Hz?
16. (a) State Larmor's Formula. (b) Suppose an electron decelerated at a constant rate '**a**' from some initial velocity v_0 down to zero, what fraction of its initial kinetic energy is lost to radiation? (assume $v_0 << c$). **(2.5 + 5 marks)**

PART - C

Answer any **FOUR** questions **(4×12.5=50)**

17. (a) State Gauss theorem. (b) Find the capacitance of two concentric spherical metal shells with radii a and b. (c) Find the capacitance per unit length of two co-axial cylindrical tubes of radii a and b. **(2.5 + 5 + 5 marks)**
18. (a) What is Gauge transformation? Explain Lorentz Gauge. (b) Find the energy stored in a section of length of a long solenoid (radius R, current I, n turns per unit length). **(8 + 4.5 marks)**
19. Derive the complete set of Lorentz transformation equations and hence arrive at Einstein velocity addition rule.
20. Find the potentials for a point charge moving with a constant velocity.
21. Show that a coaxial transmission line support TEM waves. Find the charge density λ (z, t) and the current I (z, t) on the inner conductor. **(6.5 +6 marks)**
22. Prove the uniqueness theorems in electrostatics.

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