LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – PHYSICS

FIRST SEMESTER – NOVEMBER 2015

PH 1818 - ELECTRODYNAMICS

Date : 05/11/2015   Dept. No.   Max. : 100 Marks
Time : 01:00-04:00

PART A

Answer **ALL** questions: **10 x 2 = 20 marks**

1.   Show that potential obeys the superposition principle.

2.   Establish Ampere law in differential and integral form.

3.   What are the laws of geometric optics?

4.   State Poynting's theorem.

5.   A muon is travelling through the laboratory at three-fifths the speed of light. How long does it last?

6.   How do you define a four vector?

7.   Give the Abraham-Lorentz formula for the radiation reaction force.

8.   Define radiation zone.

9.   Write a short note on Hall Magnetohydrodynamics

10.   What is cut-off frequency with reference to a waveguide?

PART B

Answer any **FOUR** questions: **4 x 7.5 = 30 marks**

11. Find the field outside a uniformly charged solid sphere of radius R and charge q.

12. Derive expressions for energy and momentum of electromagnetic waves

13. Combine the electric and magnetic field in to a single entity the Field tensor F^μ .

14. What are Lienard-Wiechart potentials? Derive expressions for the same.

15. Show that a coaxial transmission line of inner and outer radius a and b respectively admit waves with $E_z = 0$ and $B_z = 0$.

16. Prove that the retarded potentials satisfy Lorentz Gauge condition.

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PART C

Answer any **FOUR** questions: **4 x 12.5 = 50 marks**

17. State and prove first and second uniqueness theorems.

18. What is Gauge transformation? Explain Lorentz Gauge and Coulomb Gauges **(4.5+8).**

19. (a) Define invariant interval between two events and hence explain time like, space and light like events. (b) Event A happens at point (X_A=5, Y_A=3, Z_A=0) and at time t_A given by ct_A=15. Event B occurs at (10, 8, 0) and ct_B=5. Both are in system S. What is the invariant interval between A and B. (c) Two events occurring at the same place in an inertial frame are separated by a time interval of four seconds. What is the spatial difference between these two events in an inertial frame in which the events are separated by a time interval of six seconds? **(4.5+4+4)**

20. (a) Find the retarded potentials V(**r**, t) and A(**r**, t) of a point charge moving with constant velocity. (b) In an infinite straight wire the current I(t) = 0 for t 0 and I(t)=I_0 for t >0, if a constant current I_0 is turned on abruptly at t=0, find the resulting electric and magnetic fields. **(6.5+6)**

21. Obtain the general expression for electric and magnetic field components for a EM wave propagating along the z-axis of a waveguide.

22. Outline the theory of multipole expansion of electrostatic potential in powers of $\dfrac{1}{r}$.

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