LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIRST SEMESTER – **NOVEMBER 2014**

PH 1818 - ELECTRODYNAMICS

Date : 03/11/2014 Dept. No. Max. : 100 Marks

Time : 01:00-04:00

PART A

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

1. Find the electric field outside a uniformly charged solid sphere of radius R and total charge q using Gauss's law.
2. Establish Ampere law in differential and integral form.
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. Calculate the radiation damping of a charged particle attached to a spring of natural frequency ω_0 driven at frequency ω.
8. Give the Larmor formula for power radiated by a point charge.
9. What are the boundary conditions on **E** and **B** for a wave guide?
10. What are TE and TM modes in a waveguide?

PART B

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

11. Three charges are situated at the corners of the square of side a. How much work does it take to bring in another charge +q and place it on the fourth corner?
12. Two spherical cavities of radius a and b are hollowed out from the interior of a neutral conducting sphere of radius R. Point charges q_a and q_b are placed at each cavity respectively. (i) Find the surface charges σ_a, σ_b and σ_R. (ii) What is the field outside the conductor? (iii) What is the field within each cavity?
13. Arrive at an expression for the proper velocity four vector and hence establish its transformation equations.
14. Find the retarded potentials V(**r**, t) and A(**r**, t) of a point charge moving with constant velocity.
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. 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**.

PART C

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

17. Outline the theory of multipole expansion of electrostatic potential in powers of $\frac{1}{r}$.
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. Obtain the general expression for electric and magnetic field components for an EM wave propagating along the z-axis of a waveguide.
22. Prove the uniqueness theorems in electrostatics.

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