LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION - **PHYSICS**

FIRST SEMESTER – **APRIL 2013**

PH 1818 - ELECTRODYNAMICS

Date : 30/04/2013 Dept. No. Max. : 100 Marks

Time : 9:00 - 12:00

SECTION -A

Answer **all** the questions. 10 x 2 = 20

1. Prove that electrostatic field is a conservative field.
2. Use Gauss's law to find the electric field a distance 's' from an infinitely long wire having a uniform line charge density λ.
3. What is a gauge transformation? Give an example.
4. Write down the differential form of the Poynting's theorem and explain the significance of each term.
5. Write down the Lienard- Wiechert scalar potential for a moving point charge
6. Define radiation zone.
7. Represent the transformation of a four position vector.
8. Show that $\mathbf{B}^2 - \mathbf{E}^2$ is scalar invariant.
9. What are cavity resonators and mention any one of its uses?
10. Write down the continuity equation in magneto hydrodynamics and explain each term.

SECTION -B

Answer and **four** questions. 4 x 7.5 = 30

11. From the potential of an electric dipole, evaluate $\vec{E}_{dip}$ (r,θ) in spherical polar coordinates.
12. For monochromatic plane waves propagating along z-direction , obtain expressions for the average (a) energy per unit volume (b) momentum density (c) intensity.
13. Derive an expression for energy-momentum four vector and hence establish the Einstein's relativistic expression for energy.
14. Show that the retarded potential V(**r**,t) due to a continuous charge distribution satisfies inhomogeneous equation of the form $\nabla^2 V = -(\rho/\varepsilon_0)$
15. Explain energy flow and attenuation in waveguides.

SECTION -C

Answer and **four** questions. 4 x 12.5 = 50

16. Outline the theory of multi pole expansion of magnetic vector potential in powers of (1/r).
17. Obtain expressions for reflection and transmission coefficients for oblique incidence at an interface.
18. Derive an expression for $F_{\mu\nu,}$ the electromagnetic field tensor in the covariant form. Also find the contra variant form of the electromagnetic field tensor.
19. Obtain an expression for the power radiated by an oscillating electric dipole.
20. Obtain the general expression for electric and magnetic field components for a EM wave propagating along the z-axis of a waveguide. Hence derive an expression for the cut off wavelength for a TM mode of propagation in a rectangular waveguide.

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