



LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – PHYSICS

FIRST SEMESTER – NOVEMBER 2016

16PPH1MC02 / PH 1818 - ELECTRODYNAMICS

Date: 04-11-2016
Time: 01:00-04:00

Dept. No.

Max. : 100 Marks

PART A

Answer **ALL** questions:

10 x 2 = 20 marks

1. Two concentric metal spherical shells of radius 'a' and 'b' respectively, are separated by a conducting material of conductivity σ , if they are maintained at a potential difference V, what current flows from one to the other?
2. State the superposition principle in electrostatics.
3. For a yellow radiation $\nu = 5.09 \times 10^{14} \text{ s}^{-1}$ activated by sodium, determine the total energy in kJ associated with one mole of photons.
4. State Poynting's theorem.
5. The energy of a particle is three times its rest energy find its velocity.
6. State work-energy theorem.
7. Calculate the radiation damping of a charged particle attached to a spring of maximum 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. Describe Hall-Magneto Hydrodynamics.
10. Find the cut-off frequency for a given wave guide in the mode TE_{10}

PART B

Answer any **FOUR** questions:

4 x 7.5 = 30 marks

11. An electric dipole consists of two equal and opposite charges (+q and -q) separated by a distance d. Find the approximate potential at points far from the dipole.
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? (2.5+2.5+2.5)
13. Explain in detail the structure of Spacetime.
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. Show that TEM waves cannot occur in a hollow wave guide.
16. Explain Compton scattering. Derive an expression for Compton wavelength of an electron.

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 $(1/r)$.
18. Obtain Maxwell's equations in matter.
19. **(a)** 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.
(b) 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? **(8+4.5)**
20. Find the potentials of a point charge moving with a constant velocity.
21. Derive an expression for the cutoff wavelength for a TE mode of propagation in a rectangular waveguide.
22. Prove the uniqueness theorems in electrostatics.
