

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034



M.Sc. DEGREE EXAMINATION – PHYSICS
FIRST SEMESTER – NOVEMBER 2019
PPH 1502 – ELECTRODYNAMICS

Date: 01-11-2019

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, at a distance 'S' from an infinitely long straight wire which carries a uniform line charge
2. Two charged plates each of area A and charge Q are held a distance 'd' apart. What is the electrostatic pressure on the plates?
3. If a static electric force is 144 N. what is the distance between two positive charges $10\mu\text{c}$ and $4\mu\text{c}$?
4. A cylindrical resistor of cross sectional area A and length L is made from the material with conductivity . Find the current given that the potential difference between the ends is V.
5. A beam of particles of half-life 2×10^{-6} sec travels in the laboratory with speed 0.96 times the speed of light. How much distance does the beam travel before the flux fall to 0.5 times the initial flux.
6. Calculate the kinetic energy of an electron moving with a velocity of 0.98 C.
7. What is Lienard –Wiechert potentials?
8. Define radiation Zone.
9. Calculate the cut-off frequencies for the TE_{01} mode in a rectangular waveguide of dimensions of 2cm x 1cm.
10. What are the boundary conditions on E and B for a wave guide?

PART B

Answer any FOUR questions:

4 x 7.5 = 30 marks

11. The electrostatic potential $V(x, y) = 4e^{2x} + f(x) - 3y^2$ in a region where the charge density is zero. If the electric field E_x and V are at the origin find f(x).
12. Charges Q, Q and -2Q are placed on the vertices of an equilateral triangle ABC of side 'a'. Find the dipole moment of the configuration of charges irrespective of the choice of origin.
13. Explain in detail the structure of Spacetime.
14. An infinite straight wire carries a current $I(t) = 0$ (for $t < 0$) and $I(t) = I_0$ (for $t > 0$). Find the resulting electric and magnetic fields.
15. What are TEM waves? Show that TEM waves cannot occur in a hollow wave guide.

16. A long solenoid cable carries current I . Find the magnetic energy stored in a section of length l . Also calculate the self-inductance of the cable.

PART C

Answer any FOUR questions:

4 x 12.5 = 50 marks

17. (a) State and prove first and second uniqueness theorems. (b) 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. (8+4.5)
18. Obtain Maxwell's equations in matter.
19. Give the complete set of transformation equations among the components of electric and magnetic fields. Show that $E \cdot B$ is Lorentz invariant. (4.5 + 8)
20. (a) Find the retarded potentials $V(r, t)$ and $A(r, t)$ of a point charge moving with constant velocity. (b) Prove that retarded potentials satisfy Lorentz Gauge condition.
21. What are waveguides? Obtain expressions for the longitudinal components E_z and B_z .
22. (a) Derive expressions for energy and momentum of electromagnetic waves. (b) A neutral pion of rest mass m and relativistic momentum $p = \frac{3}{4}mc$ decays into two photons. One of the photons is emitted in the same direction as the original pion and the other in the opposite direction. Find the relativistic energy of each photon. (6+6.5)
