LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIRST SEMESTER – NOVEMBER 2017

17PPH1MC02 - ELECTRODYNAMICS

Date: 04-11-2017   Dept. No.   Max. : 100 Marks
Time: 01:00-04:00

PART A

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

1. An infinite plane carries a uniform surface charge . Find its electric field.

2. Find the electric field at a distance S from an infinitely long straight wire, which carries a uniform line charge .

3. A cylindrical resistor of cross-sectional area A and length L is made from material with conductivity . If the potential difference between the ends is V, what current flows?

4. Calculate the magnitude of Poynting vector at the surface of the sun. Given that power radiated by sun = 3.8×10^{26} watts and radius of the sun is 7×10^{8}m.

5. 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) at ct_B=5. Both in system S. Find the invariant interval between A & B..

6. Two lumps of clay, each of rest mass (m), collide head-on at $-$ c if they stick together, what is the mass (M) of the composite lump?

7. Consider two large metal plates each of area 'A' and charge Q on each plate. What is the electrostatic pressure on these plates?

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. Derive the cyclotron formula. A particle of charge q enters a region of uniform magnetic field B. The field deflects the particle a distance d above to original line of flight. Find the momentum of the particle. (3 + 4.5)

12. Two concentric metal spherical shell of radii a and b are separated by a conducting material of conductivity . (a) If they maintain a potential difference, what current flows from one to the other? (b) What is the resistance between the shells? (2.5+5)

13. 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 and mμ (assume m =0). Also find the velocity of the outgoing muon.

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. Consider a rectangular wave guide with dimensions 2.28cm x 1.01cm. What TE modes will propagate in this wave guide, if the driving frequency is 1.70×10^{10} Hz?

16. (a) State Larmor Formula. (b) Suppose an electron decelerated at a constant rate **a** from some initial velocity v_0 down to zero. What fraction of its initial kinetic energy is lost to radiation? (assume $v_0 << c$) (2.5 + 5).

PART C

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

17. (a) State Gauss theorem. (b) Find the capacitance of two concentric spherical metal shells with radii a and b. (c) Find the capacitance per unit length of two co-axial cylindrical tubes of radii a and b. (2.5 + 5 + 5).

18. (a) What is Gauge transformation? Explain Lorentz Gauge. (b) Find the energy stored in a section of length of a long solenoid (radius R, current I, n turns per unit length). (8 + 4.5)

19. Derive the complete set of Lorentz transformation equations and hence arrive at Einstein velocity addition rule.

20. Find the potentials of a point charge moving with a constant velocity.

21. Show that a coaxial transmission line support TEM waves. Find the charge density   (z, t) and the current I (z, t) on the inner conductor. (6.5 +6)

22. Prove the uniqueness theorems in electrostatics.

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