23P108 (Pages: 2) Name: .....

Reg.No: .....

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2023

(CBCSS - PG)

(Regular/Supplementary/Improvement)

CC19P PHY1 C03 - ELECTRODYNAMICS AND PLASMA PHYSICS

(Physics)

(2019 Admission onwards)

Time : 3 Hours Maximum : 30 Weightage

Section A

Answer ***all*** questions. Each question carries 1 weightage.

1. What do you mean by retarded potentials? Write down the expressions for retarded vector potential.
2. What do we mean when we say an incident wave has (a) perpendicular polarization and (b) parallel polarization?
3. What is the potential due to a physical dipole at a point far away from it?
4. How is standing wave ratio related to reflection coefficient? Explain.
5. Draw the equivalent circuit of a differential length of a two-conductor tranmission line.
6. Explain how do cavity resonators resemble with electronic resonant circuits.
7. Show that charged particle in the presence of magnetic field along z-azis obeys a simple harmonic oscillator equation.
8. On the basis of fluid theory, briefly explain the origin of plasma oscillations.

(8 × 1 = 8 Weightage)

Section B

Answer any ***two*** questions. Each question carries 5 weightage.

9. Derive the inhomogenous wave equation for scalar potential and then obtain the time-harmonic wave equation for scalar potential. Also, discuss about the solution for the above equation.
10. Discuss in detail, the reflection and transmission coefficient of an EM wave incident normally at a plane dielectric boundary. Mention the important theoretical observations.
11. Discuss in detail about TM waves and TE waves in a wave guide. Distinguish between their wave impedence and guide wavelength.
12. Formulate Maxwell's equations and Lorentz force law in relativistic notations.

(2 × 5 = 10 Weightage)

Section C

Answer any ***four*** questions. Each question carries 3 weightage.

13. An AC source with V= $V_0 \sin(\omega t)$ is connected across a parallel plate capacitor. Prove that the current through the wire is equal to the displacement current across the capacitor.

14. When a uniform plane wave propagates through a conducting medium, show that magnetic field lags behind the electric field.

15. Find the Poynting vector on the surface of a long straight conducting wire of radius b and conductivity σ with current I. Verify Poynting's theorem.

16. In a lossless transmission line, the velocity of propagation is 2.5×10^8m/s. Capacitance of the line is 30 pF/m. Find Inductance of the line, phase shift constant at 100MH and characteristics impedance of the line.

17. A point charge q is at rest at the origin of a coordinate system S_o. What is the electric field of this charge in a system S moving along the positive x-axis with a speed v_o relative to S_o?

18. For a low density plasma, the dispersion relation is given by $\omega^2 = \omega_0^2 + c^2k^2$, where k is the wave vector and ω_0 is the plasma frequency. Derive a relation between the phase velocity and group velocity for the plasma.

19. For an plasma of density 10^{18} m^{-3}, find the value of magnetic field at which the plasma frequency for an electron is equal its cylclotron frequency.

(4 × 3 = 12 Weightage)

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