D1APH2203 **(2 Pages)** **Name.....**
Reg.No.....

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2022
(Regular/Improvement/Supplementary)

PHYSICS
FPHY1C03-ELECTRODYNAMICS AND PLASMA PHYSICS

Time: 3 Hours **Maximum Weightage: 30**

Part A: Short answer questions. Answer *all* questions. Each carries *one* weightage.

1. Can we have more than one vector and scalar potentials for a given electric and magnetic fields? Justify.
2. Any function of the form $f(t-\frac{R}{u})$ is the solution of wave equations. But we always prefer sinusoidal functions. Explain it.
3. Explain the Skin depth of a conductor.
4. Why a Brewster angle is also called a polarizing angle?
5. Distinguish between the surface resistance and resistance per unit length of a parallel plate transmission line.
6. Define current density four vectors.
7. Give the importance of 'Vlasov equations'.
8. Why the wires of old rooftop T V receiving antennas are horizontal?

(8 × 1 = 8 weightage)

Part B: Essay questions. Answer any *two* questions. Each carries *five* weightage.

9. a) Derive the expression for approximate potentials at large distance using multipole expansion method.

   b) Calculate the electric field of a pure dipole.

   c) Consider a spherical shell of radius R having surface charge,$\sigma = kcos\theta$. Calculate the dipole moment of this charge distribution.
10. Explain the wave characteristics on finite transmission lines and show that when a finite transmission line is matched the voltage and current distributions on the line are exactly the same as though the line has been extended to infinity.
11. Express the Maxwell's equations and Lorentz force law in relativistic notations.
12. Derive the expression for Debye length. Also explain the criteria for plasma

(2 × 5 = 10 weightage)

(P.T.O.)

Part C: Problems. Answer any *four* questions. Each carries *three* weightage.

13. A uniform magnetic filed in the position Z direction passes through a circular wire loop of radius 1 cm and resistance 1 ohm lying in the X-Y plane. The filed strength is reduced 10 Tesla to 9 Tesla in 1 sec. Calculate the charge transferred across any point in the wire.

14. Prove the following relation between the group velocity u_g and phase velocity u_p in a dispersive medium.

    i) $u_g = u_p + \beta \frac{du_p}{d\beta}$

    ii) $u_g = u_p - \lambda \frac{du_p}{d\lambda}$

15. Derive the general relation for phase constant for conducting media

$$\beta = \omega \sqrt{\frac{\epsilon\mu}{2}} [\sqrt{1 + (\frac{\sigma}{\omega\epsilon})^2} + 1]^{\frac{1}{2}}$$

16. Show that (E.B) is relativistically invariant.

17. Find the magnetic field of a point charge q moving at constant velocity V.

18. It is found that the attenuation on a 50(ohm) distortionless transmission line is 0.01 (dB/m). The line has a capacitance of 0.1 (nF/m). Calculate the resistance and conductance per meter of the line. Also calculate the velocity of wave propagation.

19. Compute λ_D and N_D.

    i) A glow discharge with $10^{16} m^{-3} KT_e = 2eV$

    ii) The earth's atmosphere with $10^{12} m^{-3} KT_e = 0.1eV$

(4 × 3 = 12 weightage)