D 72980 (Pages : 2) Name.....

Reg. No.....

# FIRST SEMESTER M.A./M.Sc./M.Com. DEGREE EXAMINATION DECEMBER 2019

(CBCSS)

Physics

PHY 1C 03—ELECTRODYNAMICS AND PLASMA PHYSICS

(2019 Admissions)

Time : Three Hours Maximum : 30 Weightage

## Section A

*Answer* **all** *questions.*

*Each question carries a weightage of* 1.

1. What was the inconsistency of Ampere's law ? How did Maxwell rectify it ?
2. Show that the vector and scalar potentials are not uniquely defined for a given electric and magnetic fields ?
3. Explain why excellent conductors make good mirrors ?
4. State and explain Poyning's theorem.
5. Show that the current density four vector has zero divergence ?
6. "The invariant interval between causally related events is always timelike". Explain ?
7. Derive the expression for cyclotron frequency.
8. Write a brief note on Vlasov equation.

(8 × 1 = 8 weightage)

## Section B

*Answer any* **two** *questions.*

*Each question carries a weightage of* 5.

9. Derive the relation for the multipole expansion of electric scalar potential. Show that the electric field of a "pure" dipole can be written in the coordinate free form.
10. Derive the Fresnel's equation for reflection and transmission at oblique incidence for an electromagnetic wave falling on a dielectric interface when the polarization of the incoming wave is parallel to the plane of incidence. Obtain the relation for the Breswter's angle in this case.

**Turn over**

11. Derive the relation for the cutoff frequency for transverse electric wave passing through a rectangular wave guide. Explain why TEM waves do not occur in a hollow wave guide ?

12. Discuss the concept of Debye shielding and derive an expression for Debye length.

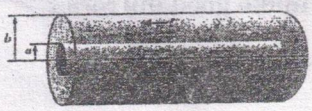
(2 × 5 = 10 weightage)

## Section C

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

13. A thin glass rod of radius R and length L carries a uniform surface charge σ. It is set spinning about itsaxis at an angular velocity ω. Find the magnetic field at a distance s >> R from the center of the rod.

14. Calculate the power (energy per unit time) transported down the cables as shown in the following figure, assuming the two conductors are held at potential difference V, and carry current I with directions as indicated in the figure




15. Prove that a lossy transmission line is as dispersive as a lossy dielectric.

16. Show that the retarded potentials satisfy the Lorentz gauge condition.

17. Define four velocity . Show that is invariant under Lorentz transformation.

18. Express Maxwell's equations using electrodynamic field tensor and its dual tensor.

19. Given that Boltzmann constant $k = 1.38 \times 10^{-23}$ J/K find the number density of an ideal gas at 0°C and atmospheric pressure $P = 1.013 \times 10^5\ Nm^{-2}$.

(4 × 3 = 12 weightage)