QP CODE: 23003149

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Reg No : .....

Name : .....

M Sc DEGREE (CSS) EXAMINATION, APRIL 2023

First Semester

CORE - PH010103 - ELECTRODYNAMICS

M Sc PHYSICS,M.Sc.Space Science

2019 ADMISSION ONWARDS

180F68A8

Time: 3 Hours Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

*Weight **1** each.*

1. Explain the physical interpretation of bound charges.
2. What is the direction of magnetic field of a very long solenoid ?Explain.
3. What is magnetization?
4. Define a monochromatic plane wave.
5. What are the possible transformations on the vector potential which leaves the magnetic field invariant in magnetostatics?
6. Calculate the electric field due to the retarded potentials for arbitrary charge and current distributions.
7. What is the velocity field term in the electric field due to a point charge moving in a specified trajectory?
8. How do you define a four acceleration α^{μ}. Write down the transformation property of four acceleration under Lorentz transformation.
9. Define Minkowski force. How is it related to the ordinary force?
10. Consider a frame $\bar{S}$ moving along the positive x direction of the S frame with velocity v. Suppose $B = 0$ in S frame, show that $\bar{B} = -\frac{1}{c^2}(v \times \bar{E})$.

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

*Weight **2** each.*

11. Two concentric spherical conducting shells is centered at the origin. The outer radius of the inner shell is r_a(where $V = 0$) and the inner radius of the outer shell is r_b (where $V = V_0$). If the charge density $\rho = 0$ in the region $r_a < r < r_b$, find the potential in this region.

12. Two long coaxial cylinders of radii a and b are separated by material of conductivity σ. If they are maintained at a potential difference V , what current flows from one to the other, in a length L?

13. A plane electromagnetic wave travelling in vacuum is incident normally on a non magnetic non absorbing medium of refractive index n= 1.5. If the real amplitude of the incident electric field is E = 2 V/m, find the amplitudes of reflected and transmitted fields under appropriate boundary conditions?

14. Show that for plasma, frequencies greater than plasma frequency, the EM waves propagate without attenuation.

15. Calculate the vector potential for an oscillating electric dipole.

16. With the inclusion of the radiation reaction force, Newton's second law for a charged particle becomes $a = \tau\dot{a} + \frac{F}{m}$, where F is the external force acting on the particle. A particle is subjected to a constant force F , beginning at time $t = 0$ and lasting until time T. Find the most general solution $a(t)$ to the equation of motion in each of the two periods $(i)\ t < 0,\ (ii)\ 0 < t < T$.

17. Show that the trace of a second rank tensor is invariant under Lorentz transformation.

18. Obtain Lorentz force law in tensor form.

(6×2=12 weightage)

Part C (Essay Type Questions)

*Answer any **two** questions.*

*Weight **5** each.*

19. Deduce magnetic dipole moment from multipole expansion. Show that the magnetic dipole moment is current times the area.

20. Prove that the magnetic field lags behind the electric field when an electromagnetic wave propagates in a conductor. Also obtain the expression for reflection and transmission coefficients at the conducting surface.

21. Show that the power radiated by a magnetic dipole (a current carrying loop of radius b which has an alternating current$I(t) = I_0 \cos\omega t$ and is placed in the $x - y$ plane centered at the origin) is proportional to ω^4.

22. Discuss the propagation of TE waves through a rectangular waveguide and obtain an expression for the cut-off frequency.

(2×5=10 weightage)