



QP CODE: 22001488

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Reg No :

Name :

M Sc DEGREE (CSS) EXAMINATION, JULY 2022

First Semester

CORE - PH010103 - ELECTRODYNAMICS

M Sc PHYSICS, M.Sc.Space Science

2019 ADMISSION ONWARDS

BB91CE3A

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

*Weight **1** each.*

1. Explain the concept of bound charges.
2. Substantiate the statement ;*changing magnetic field induces an electric field.*
3. How the energy and momentum is conserved in electrodynamics?
4. Differentiate between diffraction and dispersion of electromagnetic waves.
5. Suggest a gauge transformation in electrostatics.
6. Show that the electric field of a moving point charge reduces to Coulomb field in the static case.
7. Which are the terms in the Jefimenok's equation for electric and magnetic fields, which will give a non zero contribution to power radiated?
8. Describe how the four velocity vector transform under Lorentz transformation.
9. Comment on the statement "Magnetostatics originates when we combine electrostatics and relativity".
10. Obtain four dimensional divergence of current density four vector.

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

*Weight **2** each.*

11. The magnetic field of an infinite uniform surface current, $\vec{K} = k\hat{x}$, where k is a constant, flowing over the $x - y$ plane. Show that the field is independent of the distance from the plane.





12. Find the magnetic vector potential of a finite segment of wire carrying a current I .
13. Write down the electric and magnetic fields for a monochromatic plane wave of amplitude E_0 and frequency ω and phase angle zero traveling in the negative y direction and polarised in x direction. Sketch the wave.
14. For a particular medium, θ_c is the critical angle for total internal reflection and θ_B is the Brewster's angle for the same medium. Show that $\sin \theta_c = \cot \theta_B$.
15. Show that the advanced potential $V(r, t)$ satisfy the inhomogeneous wave equation $\square^2 V = -\frac{\rho}{\epsilon_0}$.
16. A particle of charge q moves in a circle of radius R at a constant speed v . To sustain the motion, you must, of course, provide a centripetal force mv^2/R . What additional force (F_e) must you exert, in order to counteract the radiation reaction?
17. Find the matrix describing a Lorentz transformation with velocity v along the x -axis followed by a Lorentz transformation with velocity \bar{v} along the y -axis. Does it matter in what order the transformations are carried out?
18. An air filled rectangular wave guide made of copper and having transverse dimensions $a=7$ cm. and $b=4$ cm. Find cut-off frequencies for TE_{10} and TE_{11} modes.

(6×2=12 weightage)

Part C (Essay Type Questions)

Answer any **two** questions.

Weight 5 each.

19. What is magnetization? Show that the vector potential of a magnetized object carrying a dipole moment can be expressed as the contribution from potential due to surface and volume bound currents.
20. Set up the equation of motion of free electrons in plasma and discuss the significance of plasma frequency.
21. Calculate the power radiated by an arbitrary localized current and charge distribution.
22. Check the consistency of Newton's equations of motion under the principle of relativity. Construct Minkowski force and obtain its components. Discuss the transformation properties of ordinary and Minkowski force under Lorentz transformation.

(2×5=10 weightage)

