

Reg. No.

Name

M.Sc (PHYSICS) DEGREE EXAMINATION

PH1C03 - ELECTRODYNAMICS

Time: 3 hours

Maximum: 30 weightage

PART A

Answer any **SIX** questions.
Each question carries **1** weightage.

1. What are the static and dynamic Maxwells equations?
2. What is meant by Maxwells stress tensor? Explain its significance.
3. Why TEM waves can not be transmitted through hollow waveguides?
4. Explain the term characteristic impedance.
5. What is skin depth? How it is related to the attenuation constant?
6. Distinguish between phase velocity and group velocity
7. What is meant by electric dipole radiation?
8. What is a four vector? Give the components of momentum four vector.
9. Explain proper time and proper velocity.
10. What is meant by radiative reaction?

(6 X 1 = 6 weightage)

PART B

Answer any **FOUR** questions.
Each question carries **2** weightage.

14. Verify that the Poynting vector is invariant under the transformation $\mathbf{E}' = E\cos\phi + \mathbf{B}\sin\phi$ and $\mathbf{B}' = -E\sin\phi + \mathbf{B}\cos\phi$. Give the physical significance of the transformation if $\phi = \pi/2$
15. Evaluate the magnitude of the current density \mathbf{J} in a region where the vector potential is given by $\mathbf{A} = x^2\mathbf{j} - 2xy\mathbf{k}$, where \mathbf{j} and \mathbf{k} are unit vectors.
16. Show that $\mathbf{E}^2 - \mathbf{B}^2$ is Lorentz scalar.
17. Show that $\mathbf{E} \cdot \mathbf{B}$ is relativistically invariant.

18. The lowest frequency of an electromagnetic field in a rectangular waveguide is fixed at 3 MHz. What should be the dimension of the waveguide for its propagation?
19. Show that the power radiated from a magnetic dipole varies as the fourth power of the frequency.

(4 X 2 = 8 weightage)

PART C

Answer ALL questions.

Each question carries 4 weightage

11. (a) Derive the laws of conservation of energy and momentum in electrodynamics and show that the electromagnetic fields carry energy and momentum

OR

(b) Discuss the reflection and transmission of the electromagnetic waves at oblique incidence and obtain the Snell's law.

12. (a) What are transmission lines? Derive the transmission line equations and explain the characteristics of the transmission lines.

OR

(b) Explain retarded potentials. Find the expressions for Lienard-Wiechert potentials.

13. (a) Derive an expression for the power radiated by a point charge in motion

OR

(b) Describe the theory of propagation of electromagnetic waves inside a hollow waveguide of uniform cross section.

20. (a) Reformulate Maxwell's equations and Lorentz force in tensor notation.

OR

(b) Discuss the four potential of a field and obtain the Hamilton-Jacobi equation for the motion of a particle in an electromagnetic field.

(4 X 4 = 16 weightage)