

25/2393

M.Sc. (First Semester) Examination, 2025

PHYSICS

Paper : Third

(Electromagnetic Theory)

Time : Two Hours] [Maximum Marks : 75

Note : Attempt all sections as per instructions.

Section-A

(Very Short Answer Type Questions)

Note : Attempt all the **05 five** questions. Each question carries **02 (two)** marks and answer of each question should not exceed **50** words. $5 \times 2 = 10$

1. (a) Write down the differential form of Maxwell's equations in vacuum.

P.T.O.

25/2393

(b) What is meant by displacement current.

(c) Discuss why vector $\mathbf{E} + \frac{\partial \mathbf{A}}{\partial t}$ has irrotational nature.

(d) Define the plane electromagnetic wave and write the vector form of electromagnetic wave that shows its transverse characteristics.

(e) Discuss about the cut-off frequency.

Section-B

(Short Answer Type Questions)

Note : Attempt any **05 (Five)** questions out of total **08 (Eight)** questions. Each question carries **05 (five)** marks and answer of each question should not exceed **100** words. $5 \times 5 = 25$

2. (a) Establish the law of conservation of energy in an electromagnetic field.

(b) Explain the physical significance of Maxwell's field equations in both vacuum and materialistic medium.

25/2393

- (e) What are Coulomb's and Lorentz gauges? Also discuss about their importance.
- (d) Explain the non-uniqueness of electromagnetic potentials.
- (e) Derive the general equation of plane electromagnetic waves in free space.
- (f) Write a short note on polarization of electromagnetic waves.
- (g) Establish the boundary condition of transverse magnetic (TM) mode.
- (h) Derive expression of vector potential by using the radiation due to an oscillating electric dipole.

Section-C

(Long Answer Type Questions)

Note : Attempt any **02 (Two)** questions out of total **04 (four)** questions. Each question carries **20 (twenty)** marks and answer of each question should not exceed **400** words.

2×20=40

P.T.O.

3

25/2393

3. (a) State Ampere's theorem. Explain why and how it was modified by Maxwell's for non-steady currents.
- (b) Define Green's function with reference to electrostatic problems. How Green's function is applied to the solution of potential problems?
- (c) Discuss the propagation of high frequency electromagnetic waves in plasma and derive the expression of plasma frequency.
- (d) Find the expression of magnetic field induction for transverse electric waves perfectly. Propagation in a rectangular wave guide with perfectly conducting walls.

4