

M.Sc. MEDICAL PHYSICS
SEMESTER -II EXAMINATION, JUNE-2026
(MPCC205) ELECTROMAGNETIC THEORY

[Time allotted: Three Hours]**[Max Marks: 100]****Note:** Read all the instructions carefully

Answer all questions in serial order, Draw suitable diagrams wherever necessary

Q. 1. Objective type questions: (Attempt All)**(10 x 02 = 20)**

(Very short/ Short answer/ MCQ/ One liners/ Fill in the blanks/ True/False)

- a. In the presence of a dielectric, Gauss's law is expressed in terms of.....
 - i. Magnetic flux
 - ii. Electric displacement
 - iii. Resistance
 - iv. Temperature
- b. In electrostatics, charges on conductors are
 - i. Spread uniformly throughout volume
 - ii. Concentrated only at the center
 - iii. Distributed only on the surface
 - iv. Distributed only in the dielectric
- c. The boundary condition on the normal component of magnetic induction (b) is that it must be....
 - i. Continuous across the boundary
 - ii. Discontinuous everywhere
 - iii. Zero in conductors
 - iv. Equal to electric flux
- d. The boundary condition on the tangential component of magnetic field (h) involves....
 - i. Surface current density
 - ii. Charge density
 - iii. Electric displacement
 - iv. Resistance
- e. Conservation of momentum for charged particles in fields is due to....
 - i. Poynting vector
 - ii. Electromagnetic forces
 - iii. Resistance of medium
 - iv. Magnetic flux leakage
- f. Electromagnetic waves in free space travel with....
 - i. Infinite speed
 - ii. Speed of light
 - iii. Zero speed
 - iv. Depends on frequency
- g. The Larmor formula is applicable for:
 - i. Accelerated charges
 - ii. Stationary charges
 - iii. Neutral particles
 - iv. Magnetic dipoles
- h. The modified generalization of Larmor formula applies tovelocities.
 - i. Relativistic
 - ii. Non-relativistic
 - iii. Zero velocities
 - iv. None of these
- i. Which of the following is continuity equation in differential form? (PO5, CO2)
 - i. $\nabla \cdot J = \frac{\partial \rho}{\partial t}$
 - ii. $\nabla \cdot B = 0$
 - iii. $\nabla \cdot J = -\frac{\partial \rho}{\partial t}$
 - iv. $\nabla \cdot E = \frac{\rho}{\epsilon_0}$
- j. Electrostatic potential energy of a system of two point charges q_1 and q_2 separated by a distance r is given by.... (PO5, CO2)
 - i. $U = \frac{q_1 q_2}{4\pi\epsilon_0 r^2}$
 - ii. $U = \frac{q_1 q_2}{8\pi\epsilon_0 r}$
 - iii. $U = \frac{q_1 + q_2}{4\pi\epsilon_0 r^2}$
 - iv. $U = \frac{q_1 q_2}{4\pi\epsilon_0 r}$

Q. 2. Short notes/ Short answer type questions (Attempt any Five)**(05 x 04 = 20)**

- a. Write short note on Uniqueness theorem. (PO5, CO1)
- b. What is Gauss law of magnetostatics? (PO5, CO2)
- c. Write a short note on modified Ampere's circuital law. (PO5, CO2)
- d. Explain laws of electromagnetic induction. (PO4, CO2)
- e. Discuss magnetic fields of a localized current distribution. (PO4, CO4)
- f. Write a note on retarded potentials. (PO4, CO4)
- g. What is gauge invariance? (PO4, CO3)

Q. 3. Structured questions (Attempt any Three)**(03 x 10 = 30)**

- a. Derive the electric field due to (i) a point charge and (ii) an infinite line charge using Gauss's law. (PO4, CO1)
- b. State and explain Bio-Savart's law and Ampere's law. Discuss their applications. (PO4, CO2)
- c. Explain Maxwell's equations for free space. (PO5, CO3)
- d. Derive expressions for retarded potentials in electrodynamics and explain their physical significance. (PO4, CO5)

Q. 4. Long Answer/ Essay type questions (Attempt any Two)**(02 x 15 = 30)**

- a. Explain the boundary conditions of the electromagnetic field quantities at the boundary of two insulating materials. (PO4, CO2)
- b. What do you understand by line, surface and charge densities? Derive the continuity equation in electrodynamics and discuss physical significance. (PO5, CO3)
- c. Derive the expression for power radiated by a non-relativistic charged particle in circular orbits at low velocities. Explain its physical significance. (PO4, CO5)