M.Sc. Degree Examination, February 2015

PHYSICS: MP 2.1- Classical Electrodynamics and Optics

Time: 3 Hours

Max. Marks: 80

Instructions: *Questions from 1 to 8 carry 15 marks each. Question No. 9 carries 20 marks*

1. (a) What are electromagnetic potentials? Express Maxwell's equations in terms of the electromagnetic potentials. (10)

   (b) Show that the gauge transforms A' and ϕ' satisfy the Lorentz condition if and only if the gauge functions satisfy the wave equation. (5)

OR

2. (a) Obtain an expression for retarded potentials. Explain their significance. (10)

   (b) Show that under Lorentz gauge $\vec{E}$ and $\vec{B}$ also satisfy the wave equation. (5)

3. (a) Setup an expression for the power radiated by an oscillating electric dipole. (10)

   (b) Show that the expression of power radiated by an oscillating electric dipole leads to Larmor's formula. (5)

OR

4. (a) Obtain an equation for electric field due to an electric charge moving with relativistic speeds. (10)

   (b) Write a note on Pinch effect. (5)

5. (a) Discuss the importance of Poynting theorem and hence deduce an expression for Poynting vector. (10)

   (b) Starting from Fresnel's equations obtain Brewster's law. (5)

OR

6. (a) Discuss the propagation of electromagnetic waves in diluted gaseous system and hence obtain the dispersion relation. (10)

   (b) Write a note on retardation plates. (5)

7. (a) Give the theory of multiple reflections from a plane parallel film. (10)

   (b) Briefly converse about Fabry- Perot etalon. (5)

OR

8. (a) Derive Helmholtz- Kirchhoff integral theorem and apply it to the optical range. (10)

(b) Discuss Fresnel's diffraction in brief. (5)

9. Answer **any four** of the following: (4X5=20)

(a) Obtain an expression for electric quadrupole moment.

(b) Show that charges travelling with uniform speed cannot radiate electromagnetic energy.

(c) Prove that an accelerated charge and oscillating dipole are physically equivalent.

(d) Show that $\vec{E}\cdot\vec{B}$ and $E^2-c^2B^2$ are Lorentz invariant.

(e) Deduce an expression for conductivity of an ionized gas.

(f) Derive Fresnel's formula for the propagation of light in anisotropic medium.

(g) Discuss in brief about spatial coherence.

(h) Write the conditions for sustainable interference.