PG/IS/PHS/105/24

M.Sc. 1st Semester Examination, 2024

PHYSICS

(*Electrodynamics*)

PAPER – PHS-105

Full Marks : 25

Time : 1 hour

Answer **all** questions

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

GROUP – A

Answer any **two** questions : 2×2

1. Lienard formula for the power radiation is given by

$$P = \frac{1}{4\pi\varepsilon_0}\frac{2e^2}{3c}\gamma^6\left\{\dot{\beta}^2 - \left(\vec{\beta}\times\dot{\beta}\right)^2\right\}$$

Using this formula find the expression for radiated power as 'bremsstrahlung'. Notations have their usual meanings.

2. In case of plasma define the terms : mean free path and collision cross-section.

3. Show that a short linear antenna is an inefficient radiator of energy.

4. What do you mean by 'resonance scattering' ?

GROUP – B

Answer any **two** questions : 4×2

5. Treating electric dipole to be equivalent to an accelerated charge, calculate the dipole moment amplitude p_0 in terms of charge q and acceleration a of the accelerated charge.

6. (*i*) An antenna radiates a power of 100 kW at 40 MHz. Estimate the strength of its electric field at a distance of 40 km from the source.

   (*ii*) Show that the mass-density of each type of plasma particles remain conserved. 2 + 2

7. Lorentz dispersion formula for refractive index is given by

$$n^2 = 1 + \frac{1}{\epsilon_0}\left(\frac{e^2}{m}\right)\cdot\frac{N}{\omega_k^2 - \omega^2 - i\gamma_k\omega}$$

   From this formula, deduce an expression for anomalous dispersion, Symbols have their usual meanings.

8. Deduce the expression for the collisional Boltzmann's equation in case of plasma.

GROUP – C

Answer any **one** question : 8×1

9. (*i*) Is it possible to have an electromagnetic field that appears as a purely electric field in one inertial frame and as a pure magnetic field in some other inertial frame ? Justify your answer.

(*ii*) Find the expression for the Rayleigh scattering cross-section and explain its variation with frequency. 2 + 6

10. (*i*) Show in case of hydrogen plasma that the loss of energy by cyclotron radiation is proportional to T_e^2, where T_e is the electron temperature.

(*ii*) What is ambipolar diffusion in plasma ?

(*iii*) What is electromagnetic field tensor ? 4 + 1 + 3

[Internal Assessment — 5 Marks]