2017

M.Sc. Part–I Examination

PHYSICS

PAPER—III

Full Marks : 75

Time : 3 Hours

The figures in the margin indicate full marks.

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

Illustrate the answers wherever necessary.

Use separate Answerscripts for Gr. A & Gr. B.

Group—A

[Marks—35]

1. Answer any *three* questions : 2×3

(a) What is Dirac δ-function ? Write its properties.

(b) Find the minimum energy of an electron (rest mass 0.5 MeV) that can emit cherenkov radiation while

passing through water (refactive index 1.5)

(c) A plane electromagnetic wave is travelling along positive z-direction. The maximum electric field along x-direction is 10 V/m. Find the maximum value of magneitc field in Tesla. If $\varepsilon_0 = 8.86 \times 10^{-12} \text{F/m}$, find also the approximate value of intensity.

(d) A particle of rest mass m_0 describes the circular path $x = a \cos t$, $y = a \sin t$, $z = 0$ is an inertial frame S. Find the four velocity componments.

(e) Is is possible to have an electromagnetic field that appears as a purely electric field in one inertial frame and as a purely magnetic field in some other inertial frame ? What are the criteria imposed on $\vec{A}$ and $\vec{B}$ such that ther is an inertial frame in which there is no electric field ?

2. Answer any *three* questions : 3×3

(a) Give difference between Thomson scattering and Rayleigh scattering.

(b) Find field equations in Lorentz gauge with $\vec{\nabla} \cdot \vec{A} + \mu \in \frac{\partial \phi}{\partial t} = 0$.

(c) Show that electromagentic wave can not propagate in a conducting medium without attennation.

(d) Show that electromagnetic field vectors are gauge invariant.

3. Answer any *two* questions : 2×10

(a) Write down the Lienard-Weichert (LW) potential for a single electron explaining the symbols. Find an expression for the scalar potential for an electron moving with uniform velocity $\vec{u}$ along x-direction. Also calculate the electric filed in this case and check that Gauss's law is obeyed. 2+4+4

(b) Find the expression for the Rayleigh scattering cross-section and explain its variation with frequency. What is Cherenkov radiation ? What is the condition of emission of Cherenkov radiation ? Can a neutron gives rise to Cherenkov radiation ? 1+1+1

(c) Give the Lorentz transformation of electric and magnetic fields. Define electromagnetic field tensor. 8+2

Group—B

[Marks—40]

1. Answer any *five* of the following : 5×2

(a) What do you mean by 'floating potential' ?

(b) What is 'Bennett's pinch' condition ?

(c) Define plasmasheath and Debye length.

(d) State the processes by which plasma occurs in nature.

(e) What is probe technique ?

(f) Explain photoinisation with an example.

(g) Write some examples of man-made plasma.

(h) What do you mean by 'distribution function' in plasma kinetic theory ?

2. Answer any *two* questions of the following : 2×3

(a) What are the different types of radiation emitted by free charges of a plasma.

(b) State the advantages of radiofrequency probe method over that of single probe method.

(c) In plasma physics find a quantitative relation between the temperature in Kelvin and energy in eV.

3. Answer any *one* question : 1×4

(a) Principle and function of a MHD generator.

(b) Write a brief note on controlled nuclear fusion.

4. Answer any *two* questions from the following : 2×10

(a) Show that, in pressence of magnetic field diffusion coefficient for plasma particles is reduced by a factor $\frac{1}{1+W_H^2\tau^2}$; where W_H = electron frequency ; τ = relaxation time. What is ambiploar diffusion ? 8+2

(b) What do you mean by thermal ionisation ? deduce Saha-ionisation formula. What are the applications of this formula ? 2+6+2

(c) Describe the exploding wire method used to produce ionisation at a gas in the laboratory technique and show the current-wave forms. Point out its applications. 5+4+1

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