2013

DDE

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.

Write the answers Questions of each group in separate books.

Group—A

[*Marks : 35*]

1. Answer any *three* questions : 2×3

(a) What do you mean by 'classical radius' of electron ?

(b) Define relaxation time and write the value of relaxation time for a good conductor.

(c) Starting with $\nabla \times \vec{H} = \vec{J} + \frac{\partial \vec{D}}{\partial t}$, prove $\nabla \times \vec{D} = \zeta$.

(d) Show that moon-earth transmission requires high frequency electromagnetic wave.

(e) What is Dirac δ-function ?

2. Answer any *three* questions : 3×3

(a) Prove that space interval is not invariant under L.T, while space-time interval is invariant.

(b) Show that e.m. field vectors are global invariant.

(c) Show that the scalar potential at the position defined by the vector $\vec{r}$ in uniform electric field is $\phi = -\vec{E}.\vec{r}$.

(d) Using Lienard-Wiechart potential, find the expression of electric potential due to a moving charge with uniform motion.

3. Answer any *two* questions : 10×2

(a) What is differential scattering cross-section ? Find the expression for the Rayleigh scattering cross-section and explain its variation with frequency. 2+8

(b) What is the normal rank of an electromagnetic field tensor ? Show that four Maxwell's equations are represented by only two equations with electromagnetic field tensor. 2+8

(c) (i) Find the expression for the time of collapse of the Rutherford hydrogen atom when the electron revolves in the first Bohr-orbit.

(ii) What is dynamic conductivity ? Find an expression for it in plasma medium. 4+2+4

Group—B

[Marks : 40]

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

(a) How is the plasma pressure in a pinch device balanced ?

(b) What is anomalous diffusion ?

(c) Write some practical applications of photoionization.

(d) Write two optical methods for production of plasma in a laboratory.

(e) What is Debye length ?

(f) What are the major MHD instabilities in a Toroidal pinch ?

(g) What is probe technique ?

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

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

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

(b) In plasma physics, find a quantitative relation between the temperature in Kelvin and energies in eV.

(c) Discuss the effect on the mobility of the electrons when a magnetic field is applied in a direction perpendicular to the direction of flow of electrons.

3. Answer any *one* of the following : 4×1

(a) Graphically represent the physical mechanism for the generation of electron and ion oscillations in a plasma.

(b) State and explain the conditions for the existence of plasma state.

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

(a) What do you mean by diffusion of electrons? Establish Einstein's relation. Discuss its physical significance. 2+6+2

(b) Deduce Pascheu's law. Explain the ionisation of a gas by the method of D.C. field breakdown. 8+2

(c) What is ambipolar diffusion? Find a mathematical expression for the same. Show that at $T_e = T_i$, the ambipolar diffusion coefficient is approximately twice the ion diffusion coefficient. 2+6+2
