

2015

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) In a source free region if $\vec{A} = \hat{i}x^4 + \hat{k}z^2t^2$, find \vec{E} and \vec{B} .

(Turn Over)

- (b) Give difference between conduction current density and displacement current density.
- (c) What is Dirac δ -function? Write its properties.
- (d) 2KW LASER beam is concentrated by a lens into cross-sectional area about 10^{-6} cm^2 . Find the value of poynting vector.
- (e) Write Lorentz condition and Coulomb gauge condition.

2. Answer any *three* questions : 3×3

- (a) Show that electromagnetic field vectors are gauge invariant.
- (b) Prove that space interval is not invariant under L.T., while space-time interval is invariant.
- (c) Show that in a conducting medium the magnetic energy density is greater than electrostatic energy density.
- (d) Considering the electric dipole to be equivalent to an accelerated charge, calculate the dipolemoment amplitude in terms of charge and acceleration.

3. Answer any *two* questions : 2×10

- (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) Find the expression for the total power radiated due to a small current element. What is radiation resistance ?

8+2

- (c) Find the Lorentz force in covariant form. Using the Lorentz force equation in covariant form derive the transformation law of the force.

6+4

Group—B

[Marks—40]

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

- (a) What is anomalous diffusion ?
- (b) Define photoionisation with examples.
- (c) What is probe technique ?

- (d) What do you mean by magnetic and kinetic pressure in partially ionised gas?
- (e) What is Debye-length?
- (f) State the processes by which plasma occurs in nature.
- (g) What do you mean by 'distribution function' in plasma kinetic theory?
- (h) Explain the ionisation of a gas by the method of D.C. field breakdown.

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

- (a) What are the different types of radiation emitted by free changes of a plasma?
- (b) State the advantage of radio frequency probe method over that of single probe method.
- (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. Write notes on (any one) : 1×4

- (a) M.HD generator ;
- (b) Controlled nuclear fusion.

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

- (a) What do you mean by thermal ionisation? Deduce Saha-ionisation formula and point out its application. $2+6+2$
- (b) What do you mean by diffusion of electrons? Establish Einsteins relation. Discuss its physical significance. $2+6+2$
- (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. $2+6+2$

