2017

M.Sc.

1st Semester Examination

PHYSICS

PAPER—PHS-103

Subject Code—33

Full Marks : 40

Time : 2 Hours

The figures in the right hand 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 Answer-scripts for Group-A and Group-B

(Electrodynamics)

Group—A

Answer Q. No. *1* and any *one* from the rest.

1. Answer any five bits : 5×2

(a) Define the distribution function in phase space under plasma kinetic theory. 2

(b) Write down the Boltzmann's equation in absence of collision. 2

(c) Give the difference between Thmson's and Rayligh's scattering. 2

(d) What is meant by 'self energy of electron' ? 2

(e) What is the difference between Bremstrahlung and Cherenkov radiation ? 2

(f) Why a short linear antenna is an inefficient radiator ? 2

(g) Show that $E^2 - C^2B^2$ is relativistically invariant. 2

(h) Define 'diffenential scattering coefficient'. 2

2. (a) Show that for a change particle haivng change q and moving with uniform velocity $\vec{v}$, the relation between the magnetic vector potential $\vec{A}$ and the electrostatic scalar potential ϕ is

$$\vec{A} = \frac{\vec{v}}{c^2}\phi. \qquad 2$$

(b) Lienard radiation formula is

$$P = \frac{1}{4\pi\epsilon_0}\frac{2e^2}{3c}\gamma^6\left\{\dot{\beta}^2 - \left|\vec{\beta}\times\dot{\vec{\beta}}\right|^2\right\}.$$

where notations have their usual meaning. Using this formula, show that the radiation loss in a linear accelerator is γ^2 times the radiation loss in a circular accelerator. 4

(c) Show that the loss of energy of Bremstrahlums process is proportinal to $T_e^{1/2}$ where T_e is the electron temperature. 4

3. (a) If the scalar potential at a point is due to an oscillating depole as

$$\phi = \frac{1}{4\pi \epsilon_0}\left[\frac{[p]\cos\theta}{r^2} + \frac{[\dot{p}]\cos\theta}{rC}\right],$$

show that the magnetic induction is

$$\vec{B} = \frac{1}{4\pi \epsilon_0 c^2}\left[\frac{[\dot{p}]\sin\theta}{r^2} + \frac{[\ddot{p}]\sin\theta}{rC}\right]\bar{n}_\phi$$

[notations have their usual meanings]

(b) What is plasma parameters ?

Show that $\frac{D_i}{\mu_i} = \frac{kT_i}{e}$ in case of diffusion of ions in plasma,

where, D_i = diffusion constant for ions.

μ_i = mobility coefficient of ion.

T_i = ion temperature.

k = Boltzmann's constant.

e = electronic change. 1+4

(c) Show that the e.m. field vectors are gauge invariant. 2

Group—B

Answer Q. No. *1* and any *one* from the rest.

1. Answer any *five* questions : 5×2

(a) Discuss how the grain size and strain of a polycrystalline material affect the XRD pattern.

(b) Write one advantage and one disadvantage of Neutron diffraction over X-ray Diffraction.

(c) What is the utility of Electron Spectroscopy for Chemical Analysis (ESCA).

(d) What are the different CVD unit available for different applications ?

(e) Give the different pressure range to reach UHV with proper pumping unit.

(f) *What is nanomaterials ?*

(g) What will be expression for

(a) hopping conduction

(b) drude conduction.

2. (a) Name a method to prepare single crystal and give the schematic diagram of it.

(b) Describe MBE method. Specify the advantage of this method.

(c) What are the different solution-based systhesis route to prepare ceramic and semi conductor materials.

(d) What are the differences between sputtering and pulse laser deposition techniques ? 2+4+2+2

3. (a) Show the different interaction possibilities of an electron beam when it bombards a material.

(b) Show that, the limiting value of resolution in a TEM is :

$r_{min} = 0.91(C_s\lambda^3)^{1/4}$, where C_s is the coefficient of speherical aberration.

(c) Crearly differentiate between absorption spectroscopy and emission spectroscopy with proper instrumentation.

3+4+3
