2018

M.Sc.

1st Semester Examination

PHYSICS

PAPER—PHS-103

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.

Unit—103.1

[Marks : 20]

Answer Q. No. *1, 2* and any *one* from the rest.

1. Answer any *two* questions : 2×2

(a) Find field equations in Lorentz gauge with

$$\vec{\nabla}.\vec{A}+\mu \in \frac{\partial \phi}{\partial t} = 0 .$$

(b) Prove that $\left(\vec{E}.\vec{B}\right)$ is covariant under Lorentz transformations.

(c) Show that the energy loss by cyclotron radiation in hydrogen plasma is $T_e^{1/2}$ times the Bremstrahlung radiation.

(d) In case of plasma define the terms — mean free path and collision cross-section.

2. Answer any *two* questions : 2×4

(a) What is differential scattering cross section ? Explain 'blue of the sky' from Rayleigh scattering. 2+2

(b) When an e.m. wave passes through a gaseons medium, the relative displacement of electrons and nuclei of the neutral atoms is

$$\vec{r} = \frac{e\vec{E}}{m\left(\omega_0^2 - \omega^2 - i\gamma q\right)}.$$

Find an expression for the refractive index of the medium in case of normal dispersion.

[Notations in $\vec{r}$ have their usual meanings.]

(c) (i) From Boltzmann equation show that the number of each type of particle of the plasma is concerned.

(ii) Show that the charge measured in (S') frame is the same as that in (S) frame, while the charge density is not. 2+2

(d) Deduce invariance of Maxwell's field equations in terms of four-vectors.

3. (a) Show that the average power radiated by an oscillating dipole is proportional to w^4.

(b) Show that Maxwell's equations can be expressed in terms of the field tensor ($F^{\mu\nu}$) and the dual tensor ($G^{\mu\nu}$) as

$$\frac{\partial F^{\mu\nu}}{\partial x^\nu} = \mu_0 J^\mu \text{ and } \frac{\partial G^{\mu\nu}}{\partial x^\nu} = 0 . \qquad 3+5$$

4. (a) Show that, in presence 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.

(b) Deduce Vlasov equation for plasma. 5+3

Unit—103.2

[Marks : 20]

Answer Q. No. *1*, *2* and any *one* from the rest.

1. Answer any *two* questions : 2×2

(a) What is meant by "bottom up" approach of material synthesis. Give example.

(b) Schematically explain e-beam lithography.

(c) What is the difference between Auger electron and secondary electron ?

(d) Give the schematic presentation of the important sections of TEM instrument.

2. Answer any *two* questions : 2×4

(a) (i) Why x-ray is appropriate for crystal structure information while electron is suitable for surface morphology study ?

(ii) What important informations about the materials we get from photo luminescence spectra ? 2+2

(b) (i) What do you mean by UHV chamber ? Give the pressure range in various vacuum levels.

(ii) What is RHEED ? What is the function of it in MBE ? 2+2

(c) Give the different temperature scale in experimental physics. State the way of generation and measurement of those temperature scale. 2+2

(d) What are the advantages of sputtering technique over evaporation technique to deposit thin films ? What are the basic differences of CBD and CVD ? 2+2

3. (a) What is photo-luminescenece ?

(b) Explain the method of probe microscopy with proper examples.

(c) Explain the operation of MOCVD. 1+3+4

4. (a) What do you mean by glassy materials ? What is sol-Gel technique of materials synthesis ?

(b) How X-ray can be produced ? Mention different use of X-ray to explore the properties of matter.

(c) What is the advantage of neutron bombardment ? 3+3+2

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