2022

1st Semester Examination

PHYSICS

Paper : PHYS 103

Full Marks : 40   Time : Two Hours

The figures in the margin indicate full marks.
Candidates are required to give their answers
in their own words as far as practicable.

Paper : 103.1

(Electrodynamics)

1. Answer any *two* of the following : $2 \times 2 = 4$

   (a) Explain why a half-wave antenna is efficient radiator while a dipole antenna is not?   2

   (b) Why ordinary laboratory plasmas do not radiate like blackbody?   2

   (c) What do you mean by electromagnetic field tensor $(F_{\mu\nu})$?   2

   (d) Show that $E^2 - C^2 B^2$ is relativistically invariant. [Symbols have their usual meanings].   2

P.T.O.

2. Answer any *two* of the following :   4×2=8

  (a) Evaluate the loss of energy by cyclotron radiation in case of hydrogen plasma.   4

  (b)   (i) From Boltzmann's equation show that the number of each type of particle in plasma is conserved.

      (ii) Explain the conditions for emission of Cherenkov radiation.   2+2=4

  (c) What fraction of the total radiated power by an electric dipole is radiated between ±45° of the equatorial plane?   4

  (d) Explain normal dispersion and anomalous dispersion by drawing the variation of refractive index graph.   4

3. Answer any *one* of the following :   8×1=8

  (a)   (i) Deduce an expression for the collisional Boltzmann's equation in case of plasma particles.

      (ii) Show that the total power radiated by a slowly moving accelerated charge is :

$$P = \frac{1}{4\pi \epsilon_0}\left[\frac{2q^2 a^2}{3c^3}\right]$$

      where, the terms have usual meaning.   4+4=8

  (b)   (i) Write the Maxwell's equations in a covariant form and show that the inductions of electric

and magnetic fields are the elements of a second rank antisymmetric field strength tensor.

(ii) What is space-like 4-vector?

(iii) Calculate the value of Thomson scattering cross-section.   5+1+2=8

Paper : 103.2

(Experimental Methods in Physics)

1. Answer any *two* questions :   2×2=4

   (a) Define 1 D materials with example in terms of confinement and movement of electrons in the material.

   (b) What is the advantage of Chemical Vapour Deposition technique over Physical Vapour Deposition technique to deposit thin film?

   (c) What information can be gathered from (i) XPS and (ii) FTIR.

   (d) What is Stoke's line and Anti stoke's line? What are the information we get from those lines?

2. Answer any *two* of the following :   4×2=8

   (a) Explain homoepitaxy and heteroepitaxy with example. What are the advantages and disadvantages of Molecular Beam Epitaxy (MBE) method?   2+2

P.T.O.

(b) What is the function of magnetic lens in an electron microscope? What is the different between probe microscopy and electron microscopy? 2+2

(c) Give the working principle of Atomic Force Microscopy.

(d) Describe one method of single crystal preparation.

3. Answer any *one* of the following : 8×1=8

(a) (i) What do you mean by "bottom up" and "top down" approach?

   (ii) What is electron gun?

   (iii) Discuss the different level of temperature scale in experimental physics.

   (iv) What do you mean by UHV? Give the related pump system with proper pressure level.
   2+2+2+2

(b) (i) Discuss the interaction of electron beam with matter and possible phenomena.

   (ii) What is the basic difference between TEM and SEM in term of energy, resolution and sample preparation?

   (iii) What is meant by differential thermal analyzer? Give brief comments on sol gel technique to prepare glass. 2+2+(2+2)