PG 1st Semester Examination, 2023

PHYSICS

PAPER – PHS-103.1 & 103.2

Full Marks : 50

Time : 2 hours

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

PAPER – PHS-103.1

(*Electrodynamics*)

GROUP – A

Answer any **two** questions : 2×2

1. Find the current required to radiate a power of 100 W at 100 MHz from 0.01 m Hertzian dipole.

2. Show in case hydrogen plasma that the energy loss by cyclotron radiation is $T_e^{3/2}$ times the Bremsstrahlung radiation.

3. What kinds of radiations of plasma are in the optical range and in the far ultraviolet ?

4. Find the minimum energy of an electron (rest-mass 0.5 MeV) that can emit Cherenkov radiation while passing through water (r.i. 1.5).

GROUP – B

Answer any **two** questions : 4×2

5. Deduce the Vlasav equation on plasma. Give the physical interpretation of this equation. $3 + 1$

6. Prove that the plasma diffusion perpendicular to the megnetic field is reduced by the factor of

$$\frac{1}{1+\omega_H^2 \cdot \tau}$$

where, the symbols have their usual meanings. From this, write the condition for retarding the diffusion across the magnetic field. 4

7. An antenna of length L carries alternating current of angular frequency ω. Treating it is an oscillating dipole, show that the radiation resistance produce the same power loss is

$$R_r = \frac{2\pi}{3}\left(\frac{\mu_0}{\epsilon_0}\right)^{\frac{1}{2}} \cdot \left(\frac{\omega L}{2\pi c}\right)^2$$ 4

8. Show that Thomson scattering of electromagnetic waves is independent of frequency of incident wave. 4

GROUP – B

Answer any **one** question : 8×1

9. (*a*) Derive the Lorentz law by using Lorentz transformations for force and electric field.

(*b*) Show in case of gases that the maximum and minimum values of *r.i.* occurs at the positions where the absorption coefficient reaches half its maximum value. 3 + 5

10. (*a*) If the scalar potential at a point is due to an oscillating dipole as

$$\phi = (1/4\pi \in_0).\left([p]\cos\theta/r^2 + [\dot{p}]\cos\theta/r^2\right),$$

show that the magnetic induction is

$$\vec{B} = \left(1/4\pi \in_0 c^2\right).\left([\dot{p}]\cos\theta/r^2 + [\ddot{p}]\cos\theta/r^2\right).$$

Notations have their usual meanings.

(*b*) Show that the Maxwell's field equations can be expressed in terms of the field tensor $(F^{\mu\nu})$ and the dual tensor $\left(G^{\mu\nu}\right)$ as $\partial F^{\mu\nu}/\partial x^{\nu} = \mu_0 J^{\mu}$ and $\partial G^{\mu\nu}/\partial x^{\nu} = 0$. 2 + 6

PAPER — PHS-103.2

(Experimental Methods in Physics)

GROUP – A

Answer any **two** questions : 2×2

1. What is the difference between TEM sample and SEM sample ?

2. What do you mean by migration, diffusion, association and dissociation of adsorbate molecules on a substrate ?

3. What is the advantage of e-beam lithography over optical lithography ?

4. What is the basic working principle of scanning tunnelling microscope ?

GROUP – B

Answer any **two** questions : 4×2

5. What is the difference between single crystalline and polycrystalline materials ? Describe a process of single crystal preparation technique. $1 + 3$

6. Write down the difference between probe microscope and electron microscope. What is the significance of single atom tip ? 2 + 2

7. What are the possible methods/scales for conducting low temperature measurements of physical parameters ? What are the possible methods/scales of low-pressure measurements of physical experiments ? 2 + 2

8. Explain the process of thin film deposition by molecular beam epitaxy, What is the significance of ALD ? 3 + 1

GROUP – C

Answer any **one** question : 8 × 1

9. (*a*) What are the possible interactions that may happen when a beam of electron is bombarded onto a material ?

   (*b*) What is the difference between photoluminescence and electroluminescence ?

(*c*) Write down the working principle of (*i*) DTA and (*ii*) TGA 2 + 2 + 4

10. (*a*) What is the difference between X-ray diffraction and neutron diffraction ?

(*b*) What is meant by quantum confinement in low dimensional materials ?

(*c*) Write down the working principle (*i*) VLS technique and (*ii*) sputtering. 2 + 2 + 4

[Internal Assessment – 10 Marks]