PG/IS/PHS-103/19

M.Sc. 1st Semester Examination, 2019

PHYSICS

PAPER—PHS-103

Full Marks : 40

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

Illustrate the answers wherever necessary

Write the answers to questions of each Paper in separate books wherever necessary

PHS-103.1

(*Electrodynamics*)

[*Marks* : 20]

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

1. Answer any *two* questions : 2 × 2

(*a*) Find the minimum energy of an electron (rest mass 0·5 MeV) that can emit Cerenkov radiation while passing through water (refractive index 1·33).

(*b*) Find the current required to radiate a power of 100 W at 100 MHz from a 0·01 m Hertzian dipole.

(*c*) In gas discharge and plasma physics, the term 'collision cross-section' is much more frequently used than the term 'mean free path' – Justify.

(*d*) Explain normal and anomalous dispersion by drawing the variation refractive index with wave length.

2. Answer any *two* questions : 4 × 2

(*a*) What fraction of the total power radiated by an electric dipole is radiated between $\pm 45^{\circ}$ of the equatorial plane ? 4

(*b*) (*i*) Lienard radiation formula is given by

$$P = \frac{1}{4\pi \epsilon_0}\left(\frac{2q^2}{3c}\right)\left[\dot{\beta}^2 - \left|\vec{\beta} \times \dot{\vec{\beta}}\right|^2\right]\gamma^6$$

from this formula, find the expression for the radiated power for cyclotron radiation.

(*ii*) Give a brief outline of Cherenkov effect. 2 + 2

(*c*) Prove that the ambipolar diffusion coefficient is given by

$$D_{\text{amb}} = \frac{2D_e D_i}{D_e + D_i},$$

where D_e and D_i are diffusion co-efficients for electrons and ions, respectively. 4

(*d*) Using the Lorentz force equation in covariant form, derive the transformation law for the force. 4

3. (*a*) An antenna of length L carries alternating current of angular frequency W. Treating it is an oscillating dipole, find the total power radiated. Show that the radiation resistance to produce the same power loss is

$$R_r = \frac{2\pi}{3}\left(\mu_0 / \epsilon_0\right)^{1/2} \cdot \left(\frac{WL}{2\pi c}\right)^2 . \qquad 5$$

(*b*) Why the ordinary laboratory plasmas do not radiate like black body ? 3

4. (*a*) Derive the expression for the differential cross-sections for Thomson scattering of radiation by electrons. 6

(*b*) What is electromagnetic field tensor ? 2

PHS-103.2

(*Materials Preparation and Characterization*)

[*Marks* : 20]

Answer **Q.No. 5 & 6** and any **one** from the rest

5. Answer any *two* questions : 2 × 2

(*a*) What is V. L. S. synthesis technique ?

(*b*) What is the difference between secondary electron emission and 'Auger' electron emission ?

(*c*) What do you mean by electron microscopy ? Give example.

(*d*) What do you mean by one dimensional nano-materials ? Give example.

6. Answer any *two* questions : 4 × 2

(*a*) What is the pressure range in U.H.V ? How can you reach UHV from atmospheric pressure ? What do you mean by venting ? 1 + 2 + 1

(*b*) Give the sketch of SEM instrument. What do you mean by e-gun ? 2 + 2

(*c*) What is meant by C.V.D ? How is it different from P.L.D ? 2 + 2

(*d*) Give the idea of UV-VIS absorption spectroscopy. How does it differ from IR spectroscopy ? 2 + 2

7. (*a*) What do you mean by DTA and TGA ?

(*b*) State the different temperature regions which are practically achievable.

(*c*) What is top-down approach of synthesis ? Give example. 3 + 3 + 2

8. (*a*) Give the basic working principle of STM.

(*b*) Describe briefly the process of Sol-Gel synthesis route.

(*c*) What do you mean by photo and electro luminescence ? 3 + 3 + 2