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End Semester Examination of Semester–II, 2016
Subject : PHYSICS (PG)
Paper : PHSPG–203 (Theory)
Group : A & B
Full Marks : 40
Time : 2 Hrs

The figures in the margin indicate the marks corresponding to the question

Candidates are requested to give their answers in their own word as far as practicable.

Illustrate the answers whenever necessary

Use separate Answer scripts for Group A and Group B

Group A : Full Marks 20

PHSPG 203(A)–Plasma Physics

Answer **Q1** and **any one** out of **Q2** and **Q3**:

Q1. Answer **any five** questions : 2x5=10

i) Why temperature in plasma physics is usually given in unit of energy? Show that for 1 eV the temperature is approximately 10^4 K.

ii) Compute Debye length (λ_D) and number of particles in the Debye Sphere (N_D) for the earth's ionsphere with $n = 10^{12}$ m^{-3} and KTe = 0·2 eV. Given $\varepsilon_0 = 8{\cdot}85 \times 10^{-12}$ F/m.

iii) What are solid plasma and liquid plasma? Give example.

iv) In the single probe method, the area of probe is 5 mm^2, saturation electron current 2 μA and electron density 10^{14} cm^{-3}. Calculate the electron temperature.

v) Describe how Vlasov's equation can be obtained from Boltzmann's equation.

vi) Explain the concept of phase space and volume element.

vii) Ionization potential of Na is 5·12 V. Na is subjected to this potential and becomes ionized. Find the temperature to which Na is heated by the above ionization energy. What would be the internal energy per gm atom of Na?

viii) Discuss Ambipolar diffusion in an unmagnetised plasma.

Q2. a) Derive the Potential distribution near a grid biased with fixed potential φ_0 in a plasma, i.e.

$$\varphi(x)=\varphi_0 \exp\left(-\frac{|x|}{\lambda_D}\right)$$

Where λ_D is the Debye length. 5

b) Show that the mobility of electron is reduced when a magnetic field is applied in a direction at right angles to the direction of electron flow. 5

Q3. a) Describe the method of determining the electron temperature of plasma by spectroscopic technique with photomultiplier tube arrangement.

b) What is a magnetic mirror? Describe its action. 6+(1+3)

Group B (Full Marks 20)

PHSPG 203(B)–Electrodynamics

Answer **Q1** and any one out of Q2 and Q3:

Q1. Answer **any five** questions : 2X5=10

i) In a source free region if $\vec{A}=\hat{i}x^4+\hat{k}z^2t^2$ find $\vec{E}$ and $\vec{B}$.

ii) Show that $c^2B^2 - E^2$ is invariant under Lorentz transformations.

iii) What is the rate of energy radiation per unit area from each side of a thin uniform alternating current sheet?

iv) Explain why refractive index of glass for X-rays is less than 1.

v) Express the Maxwell's inhomogenous equation in terms of 4-vector potential.

vi) Kolkata radio-station radiates a power of 200 MW at about 50 MHz from its antenna. Obtain rough estimate of the strength of its electric field at Midnapore College in Volts/cm. Distance between these two places is 80 Km.

vii) With example explain the phenomenon of 'resonance scattering'.

viii) Write difference between bremsstrahlung and Cherknov radiation.

Q2. a) Derive the expression for radiation emitted by an oscillating dipole and show its angular distribution. 7+1

b) Write the transformation equations of the electric and magnetic field vectors. 2

Q3. a) Obtain the Lorentz transformations of electromagnetic potentials. Find out the Lorentz transformation of electromagnetic fields. 3+4

b) Define differential scattering cross section. Draw and specify the variation of scattering cross section with frequency of incident electromagnetic wave. 1+2