PG/IIS/PHS-203/15

# M.Sc. 2nd Semester Examination, 2015

## PHYSICS

PAPER– PHS-203 (A & B)

*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*

## PHS-203(A)

[*Marks* : 20 ]

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

1. Answer any *five* questions : 2×5

   (*a*) What do you mean by 'floating potential' ?

   (*b*) What is 'Bennett's pinch' condition ?

   (*c*) Define plasma sheaths and Debye length.

(*d*) Graphically discuss the physical mechanism for the generation of electron and ion oscillations in a plasma.

(*e*) Explain photoionisation with an example.

(*f*) Write some examples of man-made plasma.

(*g*) What is 'tokamak' ?

(*h*) A plasma is having $Te = 300$ K and $ne = 10^{15}$ m$^{-3}$; a probe area $5 \times 10^{-4}$ m$^2$ is introduced into the plasma. Calculate the random current of electrons if the prove be given a potential with respect to cathode.

**2.** Write notes on (any *two*) : $5 \times 2$

(*i*) Controlled thermonuclear reactions and relevant plasma devices

(*ii*) Characteristics of different plasma instabilities

(*iii*) Pinch effect related to linear and toroidal pinch.

( *Continued* )

3. Write the names of the processes of radiation loss from plasma. Find an expression for the energy radiated per unit volume due to bremsstrahlung loss in plasma. Why such radiation occurs in the ultraviolet region of the spectrum ? 2+6+2

PHS-203(B)

[*Marks* : 20 ]

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

1. Answer any *five* bits : 2×5

(*a*) What are the conditions to be satisfied for a gas to be a plasma ?

(*b*) In case of plasma and superconductors prove the following relations :

$$\sigma = \frac{iK}{w} \text{ and } \nabla \times \vec{J} = -K\vec{B} \text{ where } K = \frac{Ne^2}{m}$$

(notations have their usual meanings)

(*c*) Find the expression for the dynamic electrical conductivity in plasma medium.

(*d*) Show that field vectors are gauge invariant.

(*e*) From orbit theory show that plasma is diamagnetic.

(*f*) Write Boltzmann equation in absence of collision.

(*g*) Show that Laplacian is not invariant under Lorentz transformation.

(*h*) Find the expression for the time of collapse of the Rutherford hydrogen atom when the electron revolves in the first Bohr orbit.

**2.** (*a*) So that, in presence of magnetic field diffusion coefficient for plasma particles is reduced by a factor $\frac{1}{1+W_H^2\tau^2}$

$W_H$ = electron frequency ; $\tau$ = relaxation time.

(*b*) What is ambipolar diffusion ? Show that

$$D_{amb} = \frac{2D_eD_i}{D_e+D_i} \text{ at } T_e = T_i$$

(notations have their usual meanings) 5 + 5



( *Continued* )

3. (*a*) Two equal point charges $e$ are moving with velocity $\vec{v}$ parallel to each other at a constant distance $R$-apart. What is the total force between them ?

(*b*) What is differential scattering cross-section ? Write the expression for Rayleigh scattering cross-section. Give a graphical variation of Rayleigh scattering cross-section with frequency. 10