MSC/IIS/PHY/PH1203 A&B/08

2008

PHYSICS

PAPER—PH 1203 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

GROUP—A

(*Plasma Physics*)

[*Marks* : 20]

Answer *all* questions

1. Answer any *five* from the following: 2×5

(*a*) Write few entities which are essential to describe the characteristics of plasma.

(*b*) Express the probe technique to measure the plasma parameters.

(*c*) Explain linear Pinch effect in plasma.

(*d*) Which of the following represent the condition for stable equilibrium of plasma as a conducting fluid MHD

(*i*) $\frac{B^2}{2\mu_0} = \text{Constant}$

(*ii*) $P + \frac{B^2}{2\mu_0} = 0$

(*iii*) $P + \frac{B^2}{2\mu_0} = \text{Constant}$

(*iv*) $P = 0.$

(*e*) State the dispersion relation for plasma oscillation.

(*f*) Diagramatically explain : KINK , and SAUSAGE instability in a plasma.

(*g*) What is floating potential ?

(*h*) Name the different plasma radiations operate in the optical range and in the far ultraviolet ?

2. Answer any *one* bit : 10 x 1

(*a*) What do you mean by Plasma oscillations. Discuss graphically the physical mechanism for the generation of plasma oscillations in the low pressure gas discharge and hence calculate the electron plasma frequency. 2 + 5 + 3

(*b*) Explain the Lawson criterion. State fusion reaction. Using the cylindrical configuration for a hypothetical controlled fusion reactor, discuss the system of plasma confinement. 3 + 2 + 5

GROUP—B

(*Electrodynamics*)

[*Marks* : 20]

Answer *all* questions

1. Answer any *five* bits: 2×5

(*a*) Show that the field vectors are gauge invariant.

(*b*) Show that the phase velocity of waves becomes infinite exactly at the cut-off frequency in case of a waveguide.

(*c*) Show that the scalar potential at the position defined by the vector $\vec{r}$ in uniform electric field is, $\phi = -\vec{E} \cdot \vec{r}$.

(*d*) An electromagnetic wave is passing through a non-conducting medium characterised by permittivity $10\epsilon_0$ and permeability $5\mu_0$. Find the wave impedance.

(*e*) Work out and interpret physically the zeroth component of Minkowski force on a charge.

(*f*) Prove that $(\vec{E} \cdot \vec{B})$ is covariant under L. T.

What is its significance ?

(*g*) Differentiate between Thomson and Rayleigh scattering.

(*h*) Show that the charge measured in S' is the same as that in S, while the charge density is not.

2. Answer any *one* bit: 10×1

(*a*) (*i*) Show that Maxwell's equations can be expressed in terms of the field tensor $(F^{\mu\nu})$ and the dual tensor $(G^{\mu\nu})$ as

$$\frac{\partial F^{\mu\nu}}{\partial x^{\nu}} = \mu_0 J^{\mu} \quad \text{and} \quad \frac{\partial G^{\mu\nu}}{\partial x^{\nu}} = 0.$$

(*ii*) What are retarded potentials ? What is Dirac δ –function ? Write its properties.

$5 + (2 + 1 + 2)$

(*b*) Derive an expression for the power radiated from an oscillating dipole. What is radiation resistance ? $8 + 2$