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SB-2708

M. Sc. (Sem. II) Examination

March / April – 2011

Physics : Paper - PH - 423

(Classical Electrodynamics & Plasma Physics)

Time : Hours] [Total Marks :70

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :
☛ **M.Sc (Sem. 2)**

Name of the Subject :
☛ **Physics : PH-423**

☛ Subject Code No. : **2 7 0 8** ☛ Section No. (1, 2,.....) : **Nil**

Seat No. :

Student's Signature

(2) Symbols used have their usual meaning.

(3) Figures to the right indicate full marks.

1 Attempt any **two** questions :

(a) Two infinitely long grounded metal at one plates y=0, the other at y=a are connected at $x = \pm b$ by metal strips maintained at a constant potential Vo. Draw a schematic diagram of it and find the potential inside the resulting rectangular pipe. **7**

(b) (i) Derive Poisson and Laplace's equation and discuss the use of this equation. **4**

(ii) What is significance of boundary condition ? Explain Neumann boundary conditions. **3**

(c) (i) Interpret plasma oscillation and point out plasma frequency. **4**

(ii) What is pinch effect ? Which are the instabilities associated with this effect? **3**

2 Attempt any **two** questions :

(a) Explain what is meant by a dipole, a quadrupole, and an octopole and show that the electric potential due to a linear quadrupole various inversely as the cube of the distance. **7**

(b) (i) State and prove Gauss's law for dielectrics. **4**

(ii) A long straight wire, carrying uniform line charge λ, is surrounded by rubber insulation with outer radius a. Find the electric displacement. **3**

(c) (i) Define dielectric polarization. It is though, defined geometrically. **4**

(ii) Explain dipole interaction and find expression for the torque on an dipole in the field of the other. **3**

3 Attempt any **two** questions :

(a) What is Ampere's law ? Show how his law can be applied to find the magnetic field due to an indefinitely long straight conductor carrying a steady current. **7**

(b) (i) Distinguish between magnetic vector potential and magnetic scalar potential. **3**

(ii) Find the magnetic field having a distances from a long straight wire carrying a steady current using Ampere's law.

(c) (i) Compare magnetostatics and electrostatics. **4**

(ii) Obtain the equation of continuity involving charge and current densities. Express it in a covariant from. **3**

4 Attempt any **two** questions :

(a) State Maxwell's equation for the electromagnetic field and obtain the wave equation for E and B in homogenous isotropic lossy materials. **7**

(b) (i) What do you mean by Gauge transformation ? Explain what is gauge freedom ? **4**

(ii) Find the phase velocity and the magnitude of the attenuation constant of plane waves at a frequency 10GHz in polyethylene, given, $\epsilon_r = 2.3$, $\sigma = 2.56 \times 10^{-4}$ mho/meter and $\mu = \mu_0 = 4\pi \times 10^{-7}$ henry / meter. **3**

(c) (i) What is Skin depth δ? What factors does it depend on ? Derive an expression for δ for a medium of finite conductivity σ. **4**

(ii) Find the Skin depth δ for low frequency radio waves of wave length 3×10^8 meter meter in sea water the electrical conductivity $\sigma = 4$ ohm/meter. **3**

5 Attempt any **two** questions :

(a) Explain TEM, TE and TM modes of electromagnetic wave propagation. obtain a relation between the free space wavelength for a rectangular wave guide. **7**

(b) (i) Discuss and deduce the retarded potential **4**

(ii) A rectangular wave guide has dimension 2.5cm and 5cm Determine guide wavelength λ, phase velocity and phase constant at a wavelength of 4.5 cm for dominant mode. **3**

(c) (i) Distinguish between the radiation by antenna and antenna arrays. **4**

(ii) What is physical meaning of radiation resistance ? Obtain its value for a dipole antenna and justify selection of $\lambda/2$ antenna on this basis. **3**