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AC-1412

M. Sc. (Sem. II) (Physics) Examination

April / May - 2015

Paper - PH - 423 : Classical Electrodynamics & Plasma Physics

Time : **3** 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. II) (PHYSICS)**

Name of the Subject :

☛ **P. - PH - 423 : CLAS. ELEC. & PLASMA PHY.**

☛Subject Code No. : **1 4 1 2** ☛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.

Q.1	**Write** ***any two out of the (A), (B) and (C) below.***	
(A)	Deduce the solution of Laplace's equation for a problem having azimuthal symmetry in spherical coordinates.	7
(B)	State and prove uniqueness theory of electrostatics regarding electric potential. Use it to prove that the electric field inside the conductor in zero. State and prove uniqueness theory of electrostatics regarding electric potential.	7
(C)	(i) Establish Gauss's theorem for an electrostatic field.	4
	(ii) Discuss the motion of a charged particle in a uniform magnetic field.	3
Q.2	**Write** ***any two out of the (A), (B) and (C) below .***	
(A)	Explain with necessary diagrams. What do you mean by electric monopole, a dipole, quadrupole and octopole ? Define dipole moment and derive potential due to an electric dipole.	7
(B)	(i) What are polar and non-polar molecules of a dielectric ?	4
	(ii) Establish a relationship between electric field strength E, polarization P and electric induction D.	3
(C)	Derive multipole expansion for electric field. Show that second term due to dipole moment of charge distribution while third term indicate quadrupole moment of Tensor.	7

Q.3	**Write** ***any two out of the (A), (B) and (C) below***	
(A)	Explain Biot-Savart law and from this deduce Ampere's circuital law for steady current. Define the magnetic vector potential for steady current and show that it satisfies the Poisson's equation $\nabla^2 A = -\mu_0 J$. where J is current density.	7
(B)	What do you mean by magnetic scalar potential ? Obtain an expression for the same due to a current loop.	7
(C)	Compare electrostatics and magnetostatics.	7
Q.4	**Write** ***any two out of the (A), (B) and (C) below***	
(A)	State Maxwell's equations for the electromagnetic field and obtain the wave equations for E and B for propagation of sinusoidally time varying fields in a preferred direction in a lossy material.	7
(B)	(i) Derive propagation coefficient and intrinsic impendence of good dielectrics and conductors.	**4**
	(ii) The constitutive parameters of copper are given by $\mu = \mu_0 = 4\pi \times 10^{-7}$ N/A^2 . $\varepsilon = \varepsilon_0 = 10^{-9} / 36\pi$ F/m and electrical conductivity $\sigma = 3.54 \times 10^7$ mho/m. Find the intrinsic impendence of copper at a frequency, $\nu = 3GH_z$.	**3**
(C)	(i) What is Skin depth δ? What factors does it depend on? Derive an expression of a skin depth for a medium of finite conductivity σ.	**4**
	(ii) Calculate skin depth for one mega cycle (in free space) in copper the electrical conductivity $\sigma = 5.8 \times 10^7$ mho/m, $\mu = \mu o = 4\pi \times 10^{-7}$ N/A^2.	**3**
Q.5	**Write** ***any two out of the (A), (B) and (C) below .***	
(A)	What is a wave guide ? For transverse electric waves perfectly propagating in a rectangular wave guide with perfectly conducting walls: find the cut off wavelength.	7
(B)	Show how the four-Maxwell' equations for the electromagnetic field can be written as a pair of equations in terms of the scalar and vector potentials. Discuss the gauge transformation used.	7
(C)	Define antenna array. What is meant by gain of an antenna array ? Derive an expression for the resultant field in an direction making an angle ϕ with the line of an array consisting of N equally spaced antennas carrying spaced antennas carrying currents of equal spaced antennas carrying currents of equal magnitude and having successive phase difference.	7