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## MANIPAL UNIVERSITY, MANIPAL

THIRD SEMESTER M. Sc. (PHYSICS) End Semester Examination, Nov/December,2015.

### SUBJECT: ELECTRODYNAMICS, (PHY 703)

### Time: 3 Hrs

#### Max. Marks: 50

#### Note: (i) Answer any FIVE full questions. (ii) Any missing data may suitably be assumed.

- (A) A point charge 'q' is placed at a distance 'd' from an infinite conductor held at zero potential. Using the method of images find the surface density of induced charge.
   (B) Show that field inside a uniformly polarized sphere is constant every- where and (1/3ε<sub>0</sub>) times the density of polarization and is directed opposite to the direction of polarization. (6+4 =10)
- 2. (A) State the law of Biot and Savart. Using this law, obtain an expression for the magnetic field at the axial point inside a Solenoid. What is the field if the solenoid is (i) long and the point considered is well within the solenoid (ii) long and the point considered is at the end of the solenoid?

(B) Deduce Faraday's law of electromagnetic induction  $\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$  (6+4 =10)

- 3. (A) Obtain Poynting's theorem for conservation of energy in an electromagnetic field. Discuss the significance of Poynting's Vector.
  (B) Express Lorentz force formula in terms of electromagnetic potentials. (6+4 =10)
- 4. (A) What are Lienard-Wiechert potentials? Obtain expressions for them.(B) Find the potentials of a point charge moving with constant velocity. (6+4 =10)
- 5. (A)What is a 'Wave guide'? Describe the propagation of electromagnetic wave along a hollow wave guide of uniform cross section. Obtain expressions for Wave velocity and group velocity.

(B) What is a 'Plasma'? Explain the electrical neutrality of Plasma. What is 'Debye shielding distance? (6+4=10)

6. (A) What are gauge transformations? Explain Lorentz and Coulomb gauge.

(B) State Ampere's Circuital Law. Using this obtain an expression for the magnetic field along the circular path inside a Toroid. (6+4=10)

# **Physical Constants:**

Permittivity of Free space ( $\varepsilon_0$ )	$= 8.854 \text{ x } 10^{-12} \text{ F.m}^{-1}.$
Permeability of free space $(\mu_0)$	$= 4\pi \times 10^{-7} \text{ N A}^{-2} \text{ [ or H m}^{-1-} \text{]}$
Speed of light in vacuum (c)	$= 3 \times 10^8 \text{ ms}^{-1}.$
Planck's constant (h)	$= 6.626 \text{ x } 10^{-34} \text{Js.}$
Avogadro's No.	$= 6.02 \text{ x } 10^{26} / \text{ kg mol}$
Boltzmann's Constant (k)	$= 1.381 \text{ x } 10^{-23} \text{ J K}^{-1}$
Electron charge (e)	$= 1.60 \times 10^{-19} \mathrm{C},$
Electron mass (m <sub>e</sub> )	$= 9.11 \text{ X } 10^{-31} \text{Kg} = 5.485803 \text{ X } 10^{-4} \text{ u} = 0.511 \text{ MeV/c}^2$
Proton mass (m <sub>p</sub> )	$= 1.6726 \text{ x} 10^{-27} \text{kg} = 1.0072765 \text{ u} = 938.28 \text{MeV/c}^2$
Neutron mass (m <sub>n</sub> )	$= 1.6749 \text{ x} 10^{-27} \text{kg} = 1.008665 \text{ u} = 939.573 \text{ MeV/c}^2$
1 unified mass unit (u)	$= 931.5 \text{ MeV/c}^2$

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