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MANIPAL UNIVERSITY

DEPARTMENT OF SCIENCES

THIRD SEMESTER MSc END SEMESTER EXAMINATION Nov- Dec – 2017

SUBJECT: ELECTROMAGNETISM (PHY-703)

(CREDIT SYSTEM)

TIME: 3 HOURS MAX. MARKS: 50

Answer Any FIVE questions. Assume missing data, if any.

1. (a) Consider a point charge ***q*** held a distance ***d*** above an infinite grounded conducting plane. Using classical image problem compute the potential in the region above the plane.
   (b) Using multipole expansion, find the expression for the potential of an arbitrary localized charge distribution. [5+5]

2. (a) Consider a point charge ***q*** situated at a distance ***s*** from the centre of a grounded conducting sphere of radius ***R***. Compute the potential everywhere.
   (b) Quantitatively describe the effect of magnetic field on atomic orbits.
   (c) A charge ***q*** sits at the back corner of a cube which is the origin of coordinate axes. What is the flux of the electric field ***E***, through the face parallel to yz-plane of the cube? [3+5+2]

3. (a) Derive the expression for energy in magnetic fields.
   (b) Derive Maxwell's equations inside matter.
   (c) State and prove Poynting's theorem. [3+3+4]

4. (a) For an electromagnetic wave propagating in vacuum, derive the expression for classical wave equation. Hence show that light is also electromagnetic in nature. Assuming that the waves are monochromatic plane waves, derive the expression for electric and magnetic field.
   (b) For a plane wave of frequency ω, traveling at oblique incidence, in which the incoming wave meets the boundary at a glancing angle θ_I and is approaching the interface from the left. Derive the expressions for reflected and transmitted waves. Also derive expressions for the reflection and transmission coefficients. [4+6]

5. (a) For an electromagnetic wave in a conductor derive the expression for electric and magnetic fields. What is the significance of real and imaginary parts of wave number? What is skin depth?

(b) Consider non-conductor, through which an electromagnetic wave is propagating. Derive the expression for dipole moment associated with the motion of electrons and hence obtain the expression for polarization. [5+5]

6. (a) What are retarded potentials? Derive Lienard- Wiechert potentials.

(b) Derive the expression for scalar and vector potentials for an oscillating electric dipole. [4+6]