Sixth Semester Examination – 2007

ELECTROMAGNETIC THEORY

Full Marks – 70

Time – 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*

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The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

   (a) Write equation for superposition of electric field intensity from a wire, a surface, a volume.

   (b) What is the value of electric flux inside a conducting sphere ?

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(c) What is displacement current ? Does it exit in free space or not ?

(d) What is the physical significance of the Poynting vector ?

(e) What is equation of continuity for steady currents ?

(f) Assuming that V is a scalar field and A is a vector field, classify the following fields as vector, scalar or meaningless :

$$\nabla(\nabla \times A), \quad \nabla \times (\nabla^2 V)$$

(g) Define 'characteristics impedance of free space'.

(h) Two point charges -1 nC and 4 nC are located at (0, 0, 0) and (0, 0,1). Find the energy in the system.

(i) What is retarded vector potential ?

(j) What is the importance of Brewstr angle ?

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2. (a) A point charge q is located a distance h above an infinite conducting plane. Using the method of images find the displacement density normal to the plane and hence show that the surface charge density on the plane is

$$\rho_s = -qh/2\pi r^3$$

where r is the distance from the charge q to the point on the plane. Integrate this expression over the plane to show that the total charge on its surface is –q. 5

(b) Write Laplace and Poisson's equation and their applications. 5

3. (a) Show that the capacitance of an isolated sphere of radius 'R' is $4\pi\epsilon_0 R$. 5

(b) Verify that within a conductor carrying a current I, the magnetic field strength at a distance r from the center of the wire is given by

$$H = Ir/2\pi R^2$$

Where R is the radius of the wire. The current density is constant across the cross-section of the conductor. 5

4. (a) Write Maxwell's equations and give brief explanation. 5

(b) Prove the following for parallel polarization : 5

$$E_r / E_i = \tan\{(\theta_1 - \theta_2)/(\theta_1 + \theta_2)\}$$

where

E_r = Electric field strength of reflected wave

E_i = Electric field strength of incident wave

θ_1 = Angle between incident ray and normal

θ_2 = Angle between transmitted and normal.

5. (a) Briefly explain about the terms radiation fields, radiation resistance, directive gain and directivity. 5

(b) Compare among the types of following antennas : 5

(i) Short dipole antenna

(ii) Half-wave dipole antenna

(iii) Monopole antenna.

6. (a) Write down Maxwell's field equations and explain their significance. Deduce the wave equation in time varying field for a lossless dielectric medium. 5

(b) Derive the expression for the electric field strength in case of linear, circular, elliptical polarization. 5

7. (a) What is magnetic vector potential ? Write down its physical significance. 5

(b) Derive the expression for electric field intensity due to a infinite line charge. 5

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8. Write notes on : 5×2

(a) Pattern multiplication

(b) Boundary conditions in Electric field.

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