



FACULTY OF ENGINEERING  
B.E. 2/4 (ECE) I Sem. (Old) Examination, December 2011  
ELECTROMAGNETIC THEORY

Time: 3 Hours]

[Max. Marks: 75

**Note :** Answer *all* questions from Part A. Answer *any five* questions from Part B.

PART – A

(25 Marks)

1. Describe the three orthogonal surfaces that define the cylindrical co-ordinates of a point. 3
2. What is the determinant expansion for the curl of a vector in spherical or-ordinates ? 2
3. State divergence theorem. 2
4. What is the definition of electric field intensity ? What are its units ? 2
5. What is the value of the permeability of free space ? What are its units ? 2
6. How is magnetic flux density defined interms of force on a moving charge ? Compare the magnetic force on a moving charge with electric force on a charge. 2
7. Why is it necessary to have the displacement current term on the right side of Ampere's circuital law ? 3
8. What is a boundary condition ? How do boundary conditions arise and how are they derived ? 3
9. Define wavelength what is the relationship among wavelength, frequency and phase velocity. 3
10. What is the condition for a material to be a good conductor ? Give one example of material that behave as good conductor for frequencies up to several Giga hertz. 3

PART – B

(50 Marks)

11. a) Obtain the expression for the Electric field due to an infinite surface charge at any radial distance. 6
- b) Establish Poisson's and Laplace's equation from Gauss's law. 4
12. a) Derive the expression for the electro-static energy stored in a capacitor of value 'C' interms of the total charge 'Q' as well as the voltage 'V'. 5
- b) Derive an expression for capacitance of spherical capacitor assume necessary data. 5



13. a) Discuss the different types of current distributions. How do you determine the magnetic flux density due to a current distribution ? 5
- b) A conducting plane at  $y = 1$  carries a surface current of  $10\hat{z}$  mA/m. Find 'H' and 'B' at (0, 0, 0) and at (2, 2, 2). 5
14. What is Lorentz's condition and show that time varying electric scalar potential 'V' and magnetic vector potential 'A' satisfy wave equations if Lorentz's condition is assumed ? 10
15. a) From the Maxwell's curl's equation derive the wave equations for an electromagnetic wave in free space. 5
- b) If  $\epsilon_r = 4$ ,  $\mu = \mu_0$  for the medium in which a wave with frequency  $f = 0.3$  GHz is propagating. Determine propagation constant and intrinsic impedance of the medium when  $\sigma = 0$ . 5
16. a) State and prove Poynting theorem. 5
- b) Discuss the determination of the reflected and transmitted wave fields of a uniform plane wave incident normally on a to a plane boundary between two material media. 5
17. a) Prove that  $\left(\frac{E}{H}\right) = 120\pi\Omega$  for freespace. 6
- b) List out the generalized forms of Maxwell's equations in differential form. 4