

FACULTY OF ENGINEERING

B.E. 2/4 (E & EE / Inst) II Semester (Main) Examination, May/June 2011

ELECTROMAGNETIC THEORY

Time : 3 Hours]

[Max. Marks : 75

Note : Answer all questions of Part – A. Answer five questions from Part – B.

PART – A

(Marks : 25)

1. State and explain Coulomb's law for electrostatic fields. 3
2. Three point charges -2 nc , 3 nc and 4 nc are located at $(0, 0, 1)$, $(0, 1, 0)$ and $(1, 0, 0)$, respectively. Find the energy in the system. 2
3. Find the work done in carrying a $5 - \text{c}$ charge from $P(1, 2, -4)$ to $R(3, -5, 6)$ in an electric field $E = a_x + z^2 a_y + 2yza_z \text{ V/m}$. 3
4. Define Relaxation Time of a medium. 3
5. State and explain law of conservation of magnetic flux. 2
6. Calculate the self-inductance per unit length of an infinitely long solenoid. 3
7. The conductivity of silver is $3 \times 10^6 \text{ mho/m}$. If the skin depth is 1.5 mm , find the frequency of the wave. 2
8. A Plane wave of 16 GHz frequency and $E = 10 \text{ V/m}$ propagates through the body of salt water having $\epsilon_r = 100$; $\mu_r = 1$ and $\sigma = 100 \text{ mho/m}$. Determine α , β and η . 3
9. Write the steps involved in finite element analysis. 3
10. What do you mean by equipotential line ? 2

PART – B

(Marks : 50)

11. (a) Determine D at $(4, 0, 3)$ due to a point charge $-5\pi \text{ mc}$ at $(4, 0, 0)$ and a line charge $3\pi \text{ mc/m}$ along the y -axis. 5
 (b) State and explain Gauss law for electrostatic fields. 5
12. (a) Verify whether the potential field $V = 2x^2 - 3y^2 + z^2$ satisfy Laplace's equation. 5
 (b) A spherical capacitor has inner radius 'a' and outer radius b and filled with a homogeneous dielectric with $\epsilon = \epsilon_0 k/r^2$. Show that the capacitance of capacitor is $C = \frac{4\pi\epsilon_0 k}{b - a}$. 5

(This paper contains 2 pages)

13. (a) Explain in detail magnetic scalar and vector potentials. 5
 (b) For a current distribution in free space 5

$$\mathbf{A} = (2x^2y + yz)\mathbf{a}_x + (xy^2 - xz^3)\mathbf{a}_y - (6xyz - 2x^2y^2)\mathbf{a}_z \text{ wb/m}$$
 (i) Calculate B (ii) Find the magnetic flux through a loop described by $x = 1, 0 < y, z < 2$.
14. (a) Derive the wave equation for free space. 5
 (b) State and explain Maxwell's equations for time variant fields in differential and integral forms. 5
15. (a) Explain Method of Moments Analysis. 5
 (b) Explain the numerical solution of Laplace's equation. 5
16. (a) Plane $x + 2y = 5$ carries charge $\rho_s = 8 \text{ nC/m}^2$, determine E at $(-1, 0, 1)$. 5
 (b) Calculate the self inductance per unit length of an infinitely long solenoid. 5
17. Write short notes on : 10
 (a) Boundary conditions for perfect dielectric materials.
 (b) Poynting theorem.