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 – c charge from P(1, 2, – 4) to R (3, –5, 6) in an electric field $E = a_x + z^2\, a_y + 2yza_z$ V/m.   3

4. Define Relaxation Time of a medium.   2

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 3×10^6 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 V/m propagates through the body of salt water having $\varepsilon_r = 100$; $\mu_r = 1$ and $\sigma = 100$ 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 – 5π mc at (4, 0, 0) and a line charge 3π 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 $\varepsilon = \varepsilon_0 k/r^2$. Show that the capacitance of capacitor is $C = \dfrac{4\pi\varepsilon_0 k}{b - a}$.   5

(This paper contains 2 pages)   1   **P.T.O.**

13. (a) Explain in detail magnetic scalar and vector potentials.   5

    (b) For a current distribution in free space   5

$$A = (2x^2y + yz)a_x + (xy^2 - xz^3)a_y - (6xyz - 2x^2y^2)a_z \text{ wb/m}$$

    (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 $n + 2y = 5$ carries charge $\rho_s = 8$ 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.