T. E. (Electronics) (Sem V) (Rev) 18/5/07

Engineering Electromagnetics

May-07-Exm.-Nk 61

Con-2195-07. ND-7913

(REVISED COURSE)

(3 Hours) [Total Marks : 100

N.B. (1) Question No. **1** is **compulsory.**
(2) Attempt any **four** questions out of remaining **six** questions.
(3) **Figures** to the **right** indicate **full** marks.
(4) **Necessary** assumptions should be make and clearly stated.
(5) Assume suitable data wherever **needed** and justify.

1. Explain the following : **20**
   (a) Electrostatic potential and field
   (b) Gauss's Law
   (c) Biot-Savart Law
   (d) Poisson's Equation.

2. (a) A parallel plate capacitor has a dielectric of permittivity ϵ and a volume charge density **10**
   $\rho_V (t) = \rho_0 x (x - d) \frac{C}{m^3}$ distributed throughout the dielectric volume. Find the potential and electric field intensity everywhere between the plates of the capacitor.
   (b) Charge is distributed uniformly along an infinite straight line with density ρ_L. Develop the expression for $\overline{E}$ at a general point in space. **10**

3. (a) Using Ampere's Circuital law and the equation of continuity, show that **10**

$$\overline{\nabla} \times \overline{H} = \overline{J} + \frac{\partial \overline{D}}{\partial t}$$

   and explain the concept of displacement current density.
   (b) Define characteristic impedance and derive an expressin for it for a two wire transmission line. **10**

4. (a) Derive the boundary conditions for electric and magnetic field vectors at the boundary of two dielectric media. **10**
   (b) Write down Maxwell's equations for time varying fields and arrive at the phasor forms of the equations for sinusoidal time variations. **10**

5. (a) Define poynting vector, explain poynting theorem and prove it. **10**
   (b) A radar installation transmits a wave whose magnetic field intensity is **10**

$$\overline{H} = H_0 \cos (wt - k_0 z) \hat{a}_x \frac{A}{m}.$$

   where H_0 = 25 A/m and f = 30GHz. Propagation is in free space and z is the vertical direction. Assuming place waves and lossless propagation, calculate :
   (i) The wave number for the wave
   (ii) The electroc field intensity of the wave in phasor form.

6. (a) For an electromagnetic wave propagatiing between a pair of parallel perfectly conducting planes of infinite extent in the y and z directions, analyse the TE_{mn} modes after arriving at the field components for the TE mode. **10**

   (b) A plane wave has electric field intensity $\overline{E}$ with $E_0 \cos (wt - kz) \hat{a}_y \frac{V}{m}$ with E_0 = 1000 V/m **10**
   and
   f = 300 MHz. For its propagation in free space (lossless),
   (i) Calculate the poynting Vector
   (ii) Instantaneous and time-averaged power densities in the wave.

7. Show that the power radiated by a short dipole is $p = 80\pi^2 \left(\frac{dl}{\lambda}\right)^2 I^2_{r.m.s.}$ **20**