Code No: NR220403 **NR**

II B.Tech II Semester Supplementary Examinations, November/December 2005
EM WAVES AND TRANSMISSION LINES
(Common to Electronics & Communication Engineering and Electronics & Telematics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) A charge Q_1 is at point (0,-1,0)m. Another charge Q_2 is at the point (0,2,0)m. Find the ratio Q_2/Q_1 resulting in zero force on a test charge at the origin. Q_1, Q_2 and the test charge are all of the same sign. [8]
   (b) A circular disk of radius 'a' is uniformly charged with $\rho_s C/m^2$ and is in z=0 plane. Find the Electric Field at the point (0, 0, h) along its axis. [8]

2. (a) For the magnetic potential given by $\bar{A} = x^2y \ \ \hat{X} + y^2x \ \ \hat{y} - 2xyz\hat{Z}\ Wb/m$, evaluate the magnetic field intensity at (1,2,3), and the resulting magnetic flux through the surface given by z = 1, $0 \leq x \leq 1, -1 \leq y \leq 1$. [8+8]
   (b) Explain the significance of $\bar{A}$ with reference to the magnetic and electric scalar potentials. How are its units defined? What are its applications?

3. (a) Discuss the boundary conditions at dielectric-dielectric and dielectric-conductor interface for
      i. the normal components of B and the tangential components of E and [4+4]
      ii. the normal components of D and the tangential components of H.
   (b) A uniform plane wave with $\bar{E} = E_x a_x$ propogates in a lossless simple medium ($\varepsilon_r = 4, \mu_r = 1, \sigma = 0$) in the +Z direction. Assume that E_x is sinusoidal With a frequency of 100 MHz and has a maximum value of 10^{-4} V/m at t=0 and Z = 1/8m.
      i. Write the instantaneous expression for E for any t and Z. [3+3+2]
      ii. Write the instantaneous expression for H.
      iii. Determine the locations where E_x is a positive maximum when $t = 10^{-8} sec.$

4. (a) A uniform plane wave is normally incident from air on a perfect conductor. Determine the resulting E and H fields. Sketch their variations. [8]
   (b) An EM wave is propogated through a material having $\mu_r = 5\ and\ \varepsilon\_r = 10$. Determine
      i. Velocity of propogation. [3+3+2]
      ii. Interinsic impedance of free space and of material.
      iii. Wavelength in free space and in material, if the frequency is 1 GHz.

5. (a) Explain the significance of TEM wave in a parallel plane guide, and derive an expression for the attenuation factor for TEM waves. [8+8]

   (b) Explain and sketch the nature of variations of attenuation with frequency in a parallel plate wave guide for TE, TM and TEM waves.

6. (a) In a rectangular wave guide for which a=1.5cm, b=0.8cm, $sigma = 0$, $\mu = \mu_0$, and $\varepsilon = 4\varepsilon_0$.
   $H_x = 2sin(\pi x/a)\ cos(3\pi y/b)\ sin(\pi 10^{11}t - \beta z)A/m$
   Determine

   i. The mode of operation. [2+2+2+2+2]

   ii. The cut off frequency.

   iii. The phase constant β

   iv. The propagation constant γ

   v. The intrinsic wave impedance η

   (b) A standard air filled rectangular waveguide with dimensions a = 8.636cm, b=4.318 cm is fed by a 4 GHz carrier from a coaxial cable. Determine if a TE_{10} mode will be propagated. If so calculate the phase velocity and group velocity. [6]

7. (a) Determine $Z_0, \alpha\ and\ \beta$ of an open wire line. Given that: $R = 10.4\Omega/km$, $G = 0.8\mu mho/km$, L = 3.67 mH/km, $C = 0.0083\mu F/km$, Frequency = 3 KHz. [8+8]

   (b) Define phase and group velocities and establish their mathematical relations.

8. (a) Explain the significance and principles of single stub matching. [8+8]

   (b) A loss less transmission line, $Z_o = 50\Omega$ has a load impedance of $70 + j20\Omega$. Design a single stub for achieving impedance matching at 100 MHz.

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