Code No: NR220403 **NR**

**II B.Tech II Semester Supplementary Examinations, April/May 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) What are equipotential surfaces? Give two examples of these.
   (b) A line charge $\rho_L = 400pC/m$ lies along the x-axis. The surface of zero potential passes through the point (0,5,12)m. Find the potential at point (2,3,-4)m.

2. (a) Define and explain the Biot-Savart's Law. Hence obtain the field due to a straight current carrying filamentary conductor of finite length.
   (b) In a medium of $\epsilon = 5\epsilon_o$ , $\mu = 2.5\mu_o$ , $\sigma = 0.2\ m\Omega/m.$, $E = 20\ \mu\ V/m.$, find the conduction current density. If this current density exists in a cylindrical rod of 2 cm. diameter, evaluate the current that can flow through the rod.

3. (a) In a perfect dielectric medium, the EM wave has maximum value for E of 10 V/m with $\mu_r = 1\ and\ \varepsilon_r = 4$. Find the velocity of the wave, peak poynting vector, average poynting vector, impedance of the medium and peak value of the magnetic field.
   (b) What is the inconsistency in Amperes Law? How it is rectified by Maxwell?
   (c) Show that the total displacement current between the condenser plates connected to an alternating voltage sources is exactly the same as the value of charging current (conduction current).

4. A y-polarized uniform plane wave with fields $(E_i, H_i)$ and a frequency of 100 MHz propogates in air in the + x direction and impinges normally on a perfectly conducting plane at x = 0, assuming the amplitude of $E_i$ to be 6 mV/m, write the phasor and instantaneous expressions for.
   (a) $E_i\ and\ H_i$ of the incident wave
   (b) $E_r\ and\ H_r$ of the reflected wave
   (c) $E_T\ and\ H_T$ of the total wave in air
   (d) Determine the location nearest to the conducting plane where $E_T\ and\ H_T$ are zero.

5. (a) State and Prove Poynting Theorem.
   (b) A Plane wave traveling in a free space has an average poynting vector of $5watts/m^2$. Find the average energy density.

6. An air dielectric L-band rectangular wave guide has a/b = 2 and a dominant mode cutoff frequency of 0.908 GHz. If the measured guide wave length is 40 cm, find the operating frequency, the guide dimensions, and wave number. For the above problem find the lowest frequency at which a $TE_{21}$ mode would propagate. Derive the relations used.

7. (a) Prove that a line of finite length and terminated by its characteristic impedance Z0 is equivalent to a line of infinite length.

   (b) Draw the equivalent circuit of a transmission line and explain all parameters for the cases of

      i. lossy lines,

      ii. lossless line

8. (a) Describe the formation of smith chart. Explain clearly how the Smith charts are useful to calculate transmission line parameters.

   (b) The reflection coefficient at load is 0.5 $\underline{|30^0}$ . The characteristic impedance is 100Ω. At 200MHz, calculate-

      i. The position of $V_{min}$ nearest to the load.

      ii. The ratio of voltage to current at the load.

      iii. The value of the load, and VSWR.

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