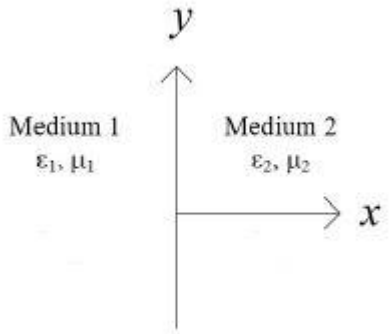
EE382 Homework #4

Assigned: Fri., Jan. 26, 2018
Due: Fri., Feb. 02, 2018
Total Points: 50

(1) An interface between two media is shown below. If $\bar{E}_1 = \hat{a}_x\alpha + \hat{a}_y\beta + \hat{a}_z\gamma$ at x=0$^-$, find $\bar{E}_2$ at x = 0$^+$.



(2) If $\bar{B}_1 = \hat{a}_x\alpha + \hat{a}_y\beta + \hat{a}_z\gamma$ at x=0$^-$ of the interface between two media shown in the previous problem, find $\bar{H}_2$ at x = 0$^+$.

(3) Write the following vector phasor quantities in time domain form. The frequency in each case is 30 MHz.

(a) $\bar{E} = -\hat{a}_x j30 - \hat{a}_y 10/j$ V/m

(b) $\bar{H} = \hat{a}_z 10e^{j4\pi/5}$ A/m

(c) $\rho = j4e^{-j\pi/3}$ C/m

(d) $\bar{B} = \hat{a}_x j2e^{(-j4\pi/3)z}e^{-20z}$ T

(e) $\bar{A} \times \bar{B}^*$ where $\bar{A} = \hat{a}_y j3e^{-j2x} + \hat{a}_z 2e^{-3x}$ and $\bar{B} = -\hat{a}_x je^{-jx} - \hat{a}_z(1+j)e^{-jx}$

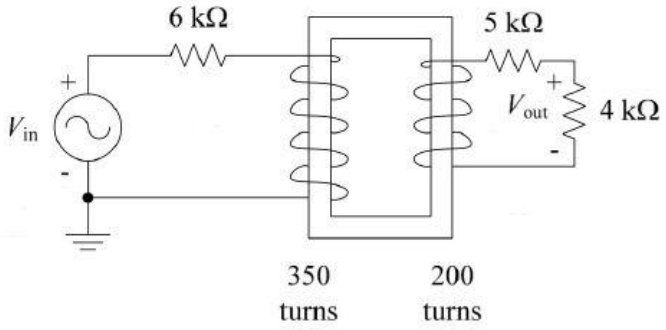
(4) Text problem 9.38.

(5) The electric field $\overline{\bar{E}(x,t)} = \hat{a}_y E_0 \cos(\beta x)\sin(\omega t)$ V/m exists in free space. Using the phasor form of this electric field, find the phasor form of the magnetic field. From this, determine the time domain form of the magnetic field.

(6) An ideal transformer has 30 turns on the primary and 120 turns on the secondary. (a) If the primary voltage is 115 V_{rms}, what is the secondary voltage if the secondary is assumed to be open-circuited? (b) Is this a step-up or step-down transformer? (c) If the secondary is now connected to a resistive load of 1.5 kΩ, what are the currents in the primary and secondary windings?

(7) An ideal transformer was designed to run an X-ray machine at a voltage of 50 kV_{rms} and 270 mA_{rms} current. The transformer operates from a 220-Vrms power supply. However, the resistance in the wires connecting the power supply to the transformer was initially ignored. Upon installation, it was realized that the supply wires have a total resistance of 0.6 Ω. By how much must the supply voltage be increased in order to maintain the same operating parameters at the transformer output?

(8) A voltage source $V_{in}(t) = 5 + 5\cos(2\pi f t)$ V is connected to an ideal transformer as shown in the figure below. If $f = 40$ kHz, find the output voltage $V_{out}(t)$.



(9) The source $V_{in}(t) = 10cos\ (2\pi \cdot 3000t)$ V is connected to an ideal transformer as shown below. Design the transformer so that maximum power is delivered to the 4-kΩ load.