Homework Set #11

Solutions will be posted by Friday, April 25, 2008

ECE 202 – Circuits and Systems II
Spring 2008

Michigan State University
Department of Electrical and Computer Engineering

Please remember to follow the rules and policies outlined in the Homework section of the ECE 202 course webpage: [http://www.egr.msu.edu/classes/ece202/radha](http://www.egr.msu.edu/classes/ece202/radha)

**Ideal Transformer**

[1] Consider the following ideal-transformer circuit. The number of turns in the primary winding is $N_1 = 50$ and the number of turns in the secondary winding is $N_2 = 500$.

(a) Find the equivalent resistor $R_{EQ}$ that is seen by the source circuit.

(b) Find the primary current $i_1(t)$ and the secondary current $i_2(t)$.

![Ideal Transformer Circuit Diagram](image-url)
Consider the following ideal-transformer circuit. The number of turns in the primary winding is \( N_1 = 10 \) and the number of turns in the secondary winding is \( N_2 = 50 \). Find the power delivered to the 300 \( \Omega \) load.

\[
\begin{align*}
\nu_T(t) &= 5 \sin(1000t) \text{ V} \\
N_1 &= 10 \\
N_2 &= 50 \\
R_L &= 300 \Omega \\
R_{EQ}
\end{align*}
\]

(Hint: The load power is \( P_L(t) = i_L(t)\nu_L(t) \), where \( i_L(t) = -i_2(t) \) is the load current and \( \nu_L(t) = v_2(t) \) is the load voltage. There are several ways for finding the power delivered to the load. One option is to evaluate the power delivered to the equivalent resistor \( R_{EQ} \); this power is the same as the load power since we have an ideal transformer with zero power loss.)
Power in Sinusoidal Steady State and Complex Power

Consider the following circuit with a source \( v(t) \) and a load circuit \( Z_L \). Evaluate the average power \( P \), reactive power \( Q \), and power factor for the following cases:

(a) The source voltage \( v(t) = 135 \sin(\omega t) \) and the current

\[
\begin{align*}
 i(t) &= 1.5 \cos(\omega t + 30^\circ)
\end{align*}
\]

(b) The source voltage has an r.m.s. phasor value \( \bar{V} = V_{\text{rms}} \angle \theta = 2.4 \angle 45^\circ \text{ kV} \), and the load impedance is \( Z_L = 250 \angle -10.5^\circ \text{ } \Omega \).
A power distribution system is represented by the following circuit, and it includes a parallel resistor-inductor load. The load draws an r.m.s. current value $I_{\text{rms}} = 12$ A from the source, which operates at 60 Hz.

(a) Evaluate the r.m.s. source voltage $V_{\text{rms}}$.

(b) Evaluate the complex power $S_L$ that is absorbed by the load, and the complex power $S_W$ that is absorbed by the wires of the distribution line.

(c) Evaluate the transmission efficiency $\eta$.