ECE 320 / ECE 329 NAME ___________________________

Quiz 2 30 January 2012

AC Circuits and Power

1. (2 points) A load connected across a 120V AC rms line absorbs 1800 Watts and 480 VArs. Calculate its current.
   a. 15 Amps
   b. 4.0 Amps
   c. 15.5 Amps
   d. 64 mAmps
   e. Other _________

C

$j := \sqrt{-1}$

$$I_1 := \frac{(1800 + j\cdot 480)\cdot V\cdot A}{120\cdot V} = (15 + 4i)\ A \qquad |I_1| = 15.524\ A$$

2. (1 point) A 120V AC rms voltage source supplies an electrical load that is entirely resistive. A typical hair dryer is often modeled as such a load. Such loads usually have a selector switch to allow the user to change the resistance value. If the user doubles the resistance value, the electrical power converted to heat
   a. doubles
   b. increases by a factor of four
   c. decreases by a factor of four
   d. is halved.
   e. Other _________________

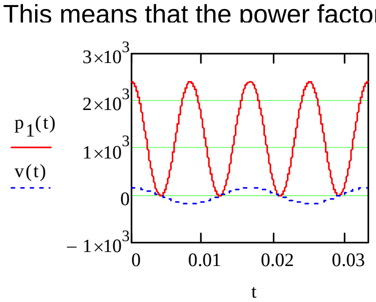
D

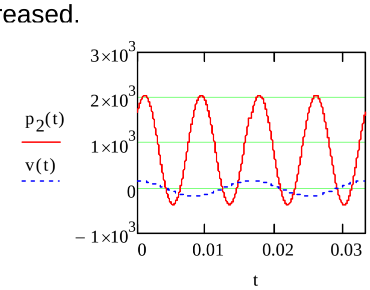
$$P = \frac{V^2}{R}$$

3. (1 point) A 120V AC rms voltage source supplies an electrical load with a known power factor. At a certain time, the power and voltage waveforms are as shown in the left graph below. An hour later, the power and voltage waveforms have changed to the waveforms shown on the right. From these waveforms, we see that
   a. The power factor decreased
   b. The power factor increased
   c. The power factor merely changed from lagging to leading but has the same numerical value
   d. The power factor did not change

A

The average power decreases while the double frequency term retains the same amplitude.
This means that the power factor decreased.

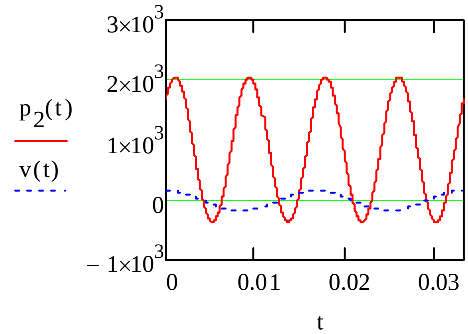




4. (1 point) For the plot of power vs. time as shown below (it's the same as the plot on the right in problem 2), the real power absorbed by the load is approximately
   a. 2000 Watts
   b. 800 Watts
   c. Zero
   d. -300 Watts
   e. Other ______________

B

The average value of this power waveform is about 800 Watts.



5. (1 point) A 120V AC rms voltage source with a (0.2+j1.0)Ohm source impedance supplies a certain load. The load impedance can be varied as we specify. At what impedance will the load absorb maximum real power?
   a. 0.02 Ohms
   b. j1.0 Ohms
   c. 1.020 $\angle$-78.7°Ohms
   d. 1.020 $\angle$+78.7°Ohms
   e. Other ________

C

The impedance that gives maximum power transfer is the complex conjugate of the source impedance.

6. (1 point) What is the maximum power that the load in problem 5 absorbs?
   a. 18kW
   b. 5.9 kW
   c. 12.7kW
   d. 6.02kW
   e. Other _________

A

$$I_6 := \frac{(120\cdot V)}{0.2\cdot\Omega + j\cdot 1\cdot\Omega + 0.2\cdot\Omega - j\cdot 1.0\cdot\Omega} = 300\,A \qquad P_6 := \left(\left|I_6\right|\right)^2\cdot(0.2\cdot\Omega) = 18\cdot kW$$

1. (3 points) Two electrical loads absorb power from a single 480V AC rms voltage source. The first electrical load absorbs 20kW at a power factor of 0.92 lagging. The second electrical load draws a current of 40 Amps that lags the voltage by 20 degrees. Find the real and reactive power that the sum of the two loads draws.

$$V_7 := 480\cdot V \qquad P_{71} := 20\cdot kW \qquad pf_{71} := 0.92\cdot lagging \qquad I_{72} := 40\cdot e^{-j\cdot 20\cdot deg}\cdot A \qquad j := \sqrt{-1} \qquad lagging := 1 \qquad kVAr := kV\cdot A$$

$$S_{71} := \frac{P_{71}}{pf_{71}} = 21.739\cdot kV\cdot A \qquad \theta_{71} := acos\left(pf_{71}\right) = 23.074\cdot deg \qquad S_{71} := S_{71}\cdot e^{j\cdot\theta_{71}} = (20 + 8.52i)\cdot kV\cdot A$$

$$S_{72} := V_7\cdot\overline{I_{72}} = (18.042 + 6.567i)\cdot kV\cdot A \qquad S_7 := S_{71} + S_{72} = (38.042 + 15.087i)\cdot kV\cdot A$$

$$P_7 := Re\left(S_7\right) = 38.042\cdot kW \qquad Q_7 := Im\left(S_7\right) = 15.087\cdot kVAr$$