

ELG 3316 *Electric Machines & Power Systems* Fall 2012

Assignment#1 – Review of AC Circuits & Phasors

Question 1

A 1kW swimming pool pump runs for 3.5 hours per day. How much energy does it consume per month (30 days)? [105 kWh per month].

Question 2

An electric kettle takes 5 minutes to boil. The rating on the kettle nameplate is 3000 W. How much electrical energy does the kettle use? [0.25 kWh]

Question 3

- Write the time domain form of the current whose phasor form is $\tilde{I} = 25.6\angle -115.4^\circ$ Amps .
- Write the phasor form of the voltage whose time-domain form is $v(t) = 100\cos(377t - 40^\circ)$ Volts .
- Draw a phasor diagram showing \tilde{I} and \tilde{V} .
- Find the complex power consumed by the load which has this \tilde{V} and \tilde{I} across its terminals, and draw the power triangle.
- Find the power factor of the load, and determine whether it is leading or lagging.
- If it is lagging, find how many VARs a capacitor in parallel with the load needs to add in order to raise the power factor to unity.

Question 4

A single-phase source whose voltage magnitude is 120 Volts¹ is serving a passive load Z_{load} through two wires whose total impedance is $(0.5 + j1.0)\Omega$. The load has a power factor of 0.85 lagging, and it draws a current of magnitude 8 Amps. What is the magnitude of the voltage across the load?

Question 5

The electrical service to your home is called 120/240 Volts, single phase, three-wire². It consists of three wires named Line1, Line2 and Neutral (N) coming into your house. The voltage drop from Line1 to N is 120 Volts, and if we use it as the phase reference we can write it as $120\angle 0^\circ$ Volts. The voltage drop from Line2 to N is then $120\angle 180^\circ$ Volts. The neutral wire is at ground potential. Suppose now that you hook up the following loads to these circuits :

¹ Recall that in power engineering it is always the RMS voltage or current that is stated.

² The term "three-wire" does not mean "three-phase".

- ◆ A fan between Line1 and Neutral that draws 5 Amps at a power factor of 0.8 lagging.
- ◆ A toaster between Line2 and Neutral that draws 11 Amps at unity power factor.
- ◆ An air conditioner between Line1 and Line2 that draws 24 Amps at a power factor of 0.85 lagging.

Perform a circuit analysis (the symbols shown on the diagram below MUST be used) to answer the following questions:

- (a). What is the total real power consumed by your house when the above appliances are turned on?
 (b). What are the current magnitudes $|\tilde{I}_{L1}|$, $|\tilde{I}_{L2}|$ and $|\tilde{I}_N|$ with the above appliances turned on?

