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ELG 3316 *Electric Machines & Power Systems Fall 2014*

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

(a). Write the time domain form of the current whose phasor form is $\tilde{I} = 25.6\angle -115.4^\circ$ *Amps*.

(b). Write the phasor form of the voltage whose time-domain form is $v(t) = 100\cos(377t - 40^\circ)$ *Volts*.

(c). Draw a phasor diagram showing $\tilde{I}$ and $\tilde{V}$.

(d). Find the complex power consumed by the load which has this $\tilde{V}$ and $\tilde{I}$ across its terminals, and draw the power triangle.

(e). Find the power factor of the load, and determine whether it is leading or lagging.

(f). 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 Volts[1] is serving a passive load Z_{load} through two wires whose total impedance is (0.5 + j1.0)Ω. 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-wire[2]. 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 $\left|\tilde{I}_{L1}\right|$, $\left|\tilde{I}_{L2}\right|$ and $\left|\tilde{I}_{N}\right|$ with the above appliances turned on?