ELEC 225 Circuit Theory I Fall 2013

Homework Assignment #8 – due in Dana 301 at noon Tuesday, Nov. 26, 2013

***Instructions, notes, and hints*:**

You may make reasonable assumptions and approximations in order to compensate for missing information, if any. Provide the details of all solutions, including important intermediate steps. You will not receive credit if you do not show your work.

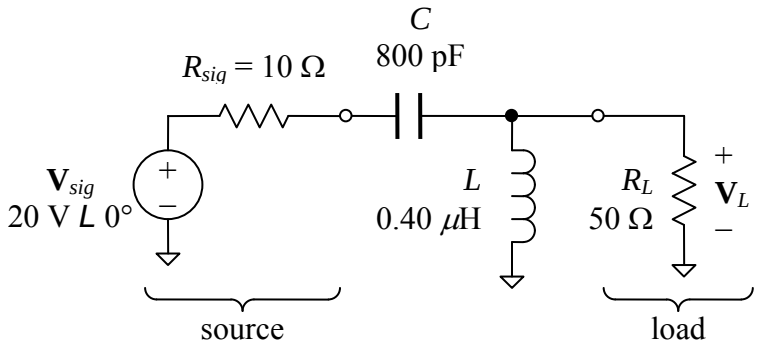
All Problems: Unless otherwise specified, complex impedances should be expressed in rectangular form, and voltage and current phasors should be expressed in polar form.

***Assignment*:**

Prob. 7.39 in the textbook plus the following additional problems:

1. Suppose a sinusoidal source with an output resistance of 10 Ω must supply a signal to a 50-Ω load. Because the load impedance is not matched to the source impedance, maximum power transfer will not be achieved. However, by placing a combination of an inductor and a capacitor between the source and the load, as shown below, the load impedance can be made to "look like" 10 Ω to the source or the source impedance to "look like" 50 Ω to the load at a specific frequency. At which of the following frequencies will the circuit provide the greatest power transfer to the load (i.e., at which frequency is the impedance match the closest)? What is the load voltage (in phasor form) at that frequency? You must show the details of your work to receive any credit.

   a. 2 MHz
   b. 10 MHz
   c. 20 MHz
   d. 100 MHz



2. The capacitor in the circuit shown in Prob. 1 will be subjected to a fairly high voltage. To avoid failure, the capacitor must be rated to withstand the largest voltage drop that will occur at any point during a complete AC cycle. To provide a margin of safety, engineers usually select components that are rated to withstand at least twice the maximum expected voltage (or current or power) they are likely to encounter. Using a "×2" safety factor, what should be the minimum voltage rating of capacitor *C* in the circuit shown in Prob. 1? What should be the minimum current rating of inductor *L* (again using a "×2" safety factor)? The operating frequency is the one you found in Part 1.

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3. At what frequency f (in Hz) is the current $\mathbf{I}_g$ in the circuit shown below in phase with the signal voltage $\mathbf{V}_g$? What is the equivalent impedance Z_{eq} seen by the source (represented by the $\mathbf{V}_g$ and $\mathbf{R}_g$ combination) at that frequency?