Massachusetts Institute of Technology
Department of Electrical Engineering and Computer Science
6.061/6.979 Introduction to Power Systems

Problem Set 1 | Issued February 5, 2003
Due February 12, 2003

Reading Assignment: Class Notes, Chapter 1

Problem 1: Your ordinary household electrical system is single phase and employs a voltage of 120 V, RMS. What can a circuit with a 15 A breaker handle?

- In Watts?
- A motor, rated in horsepower? Ignore questions of power factor and motor efficiency here: we will do those later.
- A heater, rated in British Thermal Units/hour.

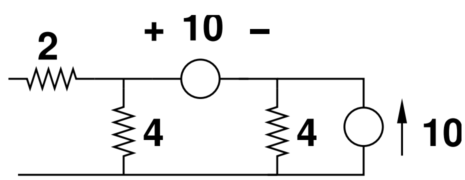

Figure 1: Circuit

Problem 2: Find the Thevenin equivalent for the circuit shown in Figure 1.

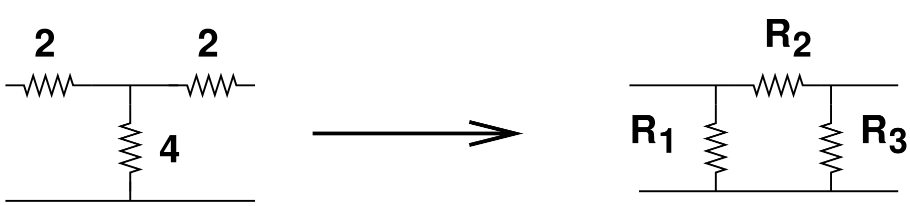

Figure 2: Circuit

Problem 3: Figure 2 shows two circuits, one with resistor values, the other with symbols. Show that these two circuits are equivalent if the values represented by the symbols are chosen correctly. Find the value of the symbols.

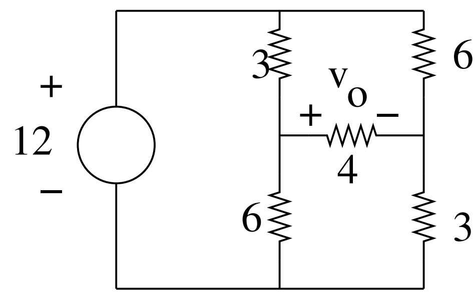

Figure 3: Loaded Bridge

Problem 4: With reference to Figure 3, find the output voltage vo. You may do this any way but will probably find it expedient to first determine the Thevenin equivalent of the circuit that excludes the horizontally oriented resistor. This circuit is called a 'Wheatstone Bridge' and is widely used.

Problem 5: Find a computer the can run MATLAB and get it to plot a nice copy of the function

$$F(t) = 100\cos(\omega t)e^{-\frac{t}{\tau}}$$

over the interval $0 < t < 1/2$, for values of

$$\begin{aligned} \omega &= 377\text{Radians/second} \\ \tau &= \frac{1}{2}\text{second} \end{aligned}$$

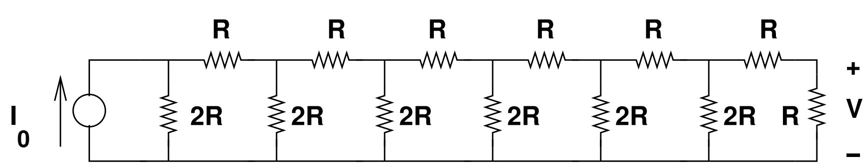

Figure 4: Magic Ladder Circuit

Problem 6: For 6.979 only Figure 4 shows a 'magic ladder' network driven by a current source at one end. Assume the value of each of the resistors is $R = 1k\Omega$ and the value of the current source is $I_0 = 10mA$. What is the output voltage V?

Hint: There is an easy way of doing this problem and there is a very hard way of working it. This circuit has some very nice properties, which is why it is called a 'magic ladder'. If you peer at it for a moment and consider the 'driving pont' impedance at each of its nodes you can probably figure the easy way of working this problem.