6.061 / 6.690 Introduction to Electric Power Systems
Spring 2007

Massachusetts Institute of Technology
Department of Electrical Engineering and Computer Science
6.061/6.690 Introduction to Power Systems

Problem Set 1 Issued: Ses #1

Due: Ses #3

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 20 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.

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

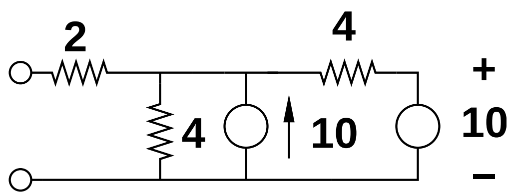

Figure 1: Circuit

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.

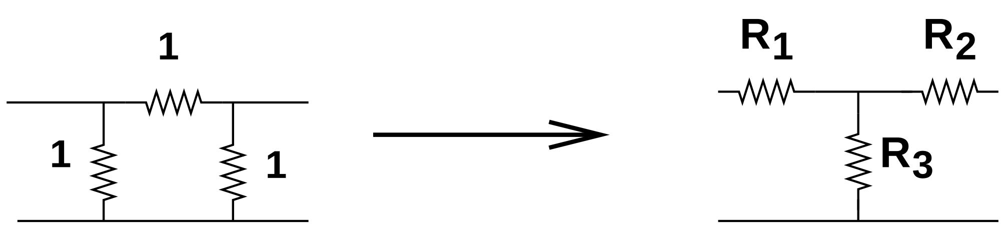

Figure 2: Circuit

Problem 4: Figure 3shows a Wheatstone Bridge, loaded with a resistor at its output. Find the output voltage v_o. 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.

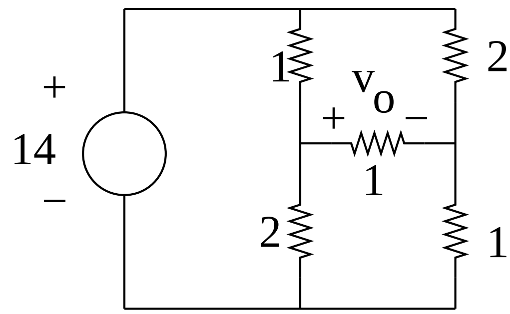

Figure 3: Loaded Bridge

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

$$\omega = 377\text{Radians/second}$$
$$\tau = \frac{1}{2}\text{second}$$

Problem 6: For 6.690 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 either R or $2R$ where is $R = 1k\Omega$ The value of the voltge source is $V_0 = 10V$. Find the Thevenin Equivalent Circuit at the output terminals. What is the output voltage V? What is the equivalent resistance?

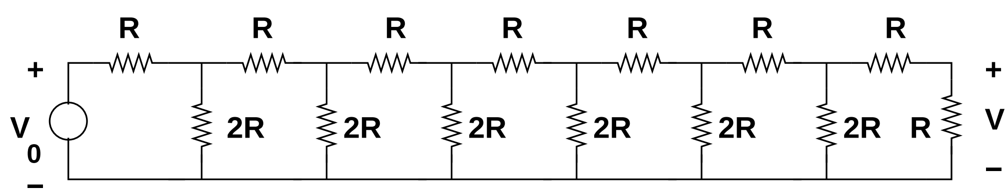

Figure 4: Magic Ladder Circuit

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.