This is due with Problem Set 3 on 2/25/2005 at recitation.

Problem 1: Light Bulb Temperature

Section 2.2 of the notes presents data for the temperature of a light bulb as it is turned on and then off. The graph in Figure 2.8 shows the temperature as a function of time. While it's not mentioned in the notes, this data is from a 75W lamp; that is the power into the bulb when it's on is 75W. For the bulb system:

(a) Propose a first-order differential equation that can reasonably fit the measured data. This should include terms for the bulb thermal capacitance and the bulb thermal resistance. Show your thinking in developing this model. Using the data given, what are numerical values and units for the system time constant in seconds, and the thermal capacitance and thermal resistance? Explain how you computed these.

(b) Now suppose the bulb is initially in equilibrium with the ambient temperature. The same experiment is performed with an input power of 150W. Make a sketch of the resulting bulb envelope temperature rise as a function of time. Note: This should be a relatively easy exercise; think about linearity!

The files bulbdata.m and bulbfit.m may be helpful to you and can be found on the assignments section under Problem Sets.