Homework Assignment:

1. In MATLAB, compare the exact solution of a suddenly, symmetrically cooled wall to a multi-node equivalent circuit model. Set the initial temperature of the entire wall to be 37 °C and the temperature of the boundaries to be 25 °C. Assume that the wall is made of 0.5-m thick stainless steel and has a height that is much, much larger than the thickness.
   a. Start with a small number of nodes and find the impedance matrix. Calculate the estimated temperature (T_{est}) as a function of time for each element.
   b. Using the exact solution derived in class, calculate the temperature (T_{exact}) as a function of position and time.
   c. Plot both T_{est} and T_{exact} as functions of position for several different points in time. How well does T_{est} match T_{exact}?
   d. Come up with an algorithm for generating the impedance matrix and forcing vector for n number of nodes. Increase n until you are satisfied that you have a sufficient number of nodes to adequately estimate the exact solution. How many nodes did you use?

   (For fun, see if you can make an "animation" in MATLAB that shows T_{est} and T_{exact} as functions of position and time.)

2. A steel piston cylinder wall is subjected to an oscillating surface temperature which we approximate as $T = 650\,°C + (300\,°C)\cos(\omega t)$. The piston cycles eight times per second.
   a. To assess the thermal stress, plot the amplitude of the temperature variation in the steel as a function of depth.
   b. If the cylinder is 1 cm thick, can we view it as having infinite depth? Why or why not?