EE 4770 **Homework 1** **Due: 18 February 1998**

Problem 1: Design a circuit to convert temperature, $x \in [200\,\mathrm{K}, 220\,\mathrm{K}]$, to a voltage $H(x) = (x - 200\,\mathrm{K})\frac{\mathrm{V}}{10\,\mathrm{K}}$. The temperature is to be measured by a thermistor with $\beta = 3000\,\mathrm{K}$ and $R_0 = 0.059\,\Omega$. Use the simple linear model, $H_{\mathrm{t}4}$, for designing your circuit. Draw a schematic, and indicate all component and supply values.

Assuming that $H_{\mathrm{t}2}(x)$ is exact, what would the output of the circuit be at $x = 200\,\mathrm{K}$ and $x = 220\,\mathrm{K}$?

Problem 2: A building has a water tank and boxes on its roof, the roof is not strong enough to hold the boxes when the tank is full so a system is needed to determine the weight of the water (so the people living under the roof will know how many boxes to remove—or should have removed—from the roof). The tank is a perfect cylinder, with its axis parallel to the plane of the roof, which is flat. (The cylinder is lying down, like a pen on a desk.) The inside of the tank is 5 meters long and the inside radius is one meter. Water level inside the tank is to be measured with (no surprise) a float. Assume that the float and anything else inside the tank have negligible volume and mass. Design a system to convert the mass of the water in the tank, x, to a floating point number $H(x) = x/\,\mathrm{kg}$, with an accuracy of at least 500 grams. Be sure to include the following in your solution:

- A diagram showing the float and its range of motion.
- A mapping between water level and mass.
- The choice of ADC.
- A justification for the ADC precision. (Be sure to give this a little thought).
- A schematic diagram of the conditioning circuit, simple though it can be.
- The interface routine, showing how the value read from the ADC is converted into kilograms.

Hint: Do not attempt to work with a mapping from water mass to float position. Instead, determine the water level in the interface routine, then convert to mass.