EE 4770 **Homework 4** **Due: 7 April 1997**

Problem 1: Design a system to convert strain $x \in [-0.0001, 0.0001]$ to a floating point number given by $H(x) = 1.3x$ to be written to variable `scaled_strain` using strain gauges with response $H_t(\epsilon) = R_0(1 + 2\epsilon)$, where $R_0 = 150\,\Omega$. Strain gauges can be mounted to obtain complementary responses; there is room to mount as many strain gauges as needed.

Design the circuit assuming that arbitrary voltage sources are readily available (*e.g.*, 1.14285714285714285 V) and strain gauges are inexpensive but op-amps and instrumentation amplifiers are expensive. Use four strain gauges.

Problem 2: With a ski-type exercise machine an exerciser uses his or her feet to slide ersatz skis back and forth. Tracks limit the skis' motion to one axis (the direction of simulated travel); the exerciser is held in place by a waist-height cushion. The skis are two meters long; assume that both skis cannot simultaneously move backward. Define simulated skiing distance to be the total backward distance that both skis travel. Using two-way coded displacement transducers, design a system to convert simulated skiing speed $x \in [0, 40\,\mathrm{km/hr}]$ to an integer, $H(x) = x\frac{1}{\mathrm{km/hr}}$. The solution should not include a computer, instead it should use logic gates, registers, adders, etc., to convert the CDT output to the speed. Be sure to specify the spacing and number of marks on the CDT, counter and registers sizes, the frequency of any clocks used, and any other relevant details.