EE 4770 Homework I Due: 1 February *1993*

Problem 1: The water level in a tank is to be measured using a variable resistor. Design a conversion circuit with an output $v_o = \frac{x}{100\,\text{mm}}\,\text{V}$, where x is the water level. The output should be 0.00 volts when the tank is empty and 10.0 V when the tank is full. The variable resistor will read 47.0 kΩ when the tank is empty and 1.00 kΩ when the tank is full. (The variable resistor cannot be changed.)

Problem 2: Design an op-amp threshold detector with $v_{\text{th}-\text{low}} = 5.00\,\text{V}$ and $v_{\text{th}-\text{high}} = 6.00\,\text{V}$.

EE 4770 Homework II Due: 15 February *1993*

Problem 1: A system is to measure the temperature difference between two sides of a barrier. The system is to use a wheatstone bridge, an instrumentation amplifier, and four thermistors. Each thermistor has $\beta = 3200\,\text{K}$ and $R_A = 0.0500\,\Omega$. The bridge excitation voltage [denoted v_E in RTS '95] is to be 15 V. In the schematic diagram show the location of each thermistor with respect to the barrier. Call the output of the circuit v_o and the temperature difference ΔT. For what instrumentation amplifier gain will $v_o = 10.0\Delta T\frac{\text{V}}{\text{K}}$ at $T \approx 250\,\text{K}$ and $\Delta T \in [-1.00, 1.00]$?

EE 4770 Homework III Due: 5 March *1993*

Problem 1: A Type-R thermocouple is at a temperature of 1506 °C. It is connected to copper wires with an isothermal block. The copper wires are connected to a voltmeter which reads 17.412 mV. What is the temperature of the isothermal block?

Problem 2: Find a 60-Watt light bulb package. Assuming the bulb irradiates uniformly in all directions find the illuminance on a point at 2 meters from the bulb. Why was the first assumption made? Does the first assumption help in finding the luminous intensity?

Problem 3: Estimate K_s for the CLT 4140 phototransitor using the attached manufacturer's datasheet.

EE 4770 Homework IV Due: 14 April *1993*

Problem 1: Design a circuit to convert temperature to a digital quantity. Temperature in the range of 300 to 301 K should be measured so that $N = (T - 300\,\text{K})255/\,\text{K}$, where N is the circuit output. The circuit should be based on a single ramp analog to digital converter, *with one of the components replaced by a thermistor.* In order to obtain the proper output the counter circuit as used in a typical single ramp converter cannot be used; make the appropriate modifications. Do not use any arithmetic components (*e.g.,* adders) in your design. Specify values for all components and supplies. Use a thermistor with $R_A = 0.05\,\Omega$ and $\beta = 3200$, and a precision supply of $v_r = 5.00\,\text{V}$.

Problem 2: Design a three-step 12 bit analog to digital converter (similar to the two-step converter described in class). The converter should convert voltages in the range of 0 to 20 V.