Name _____

Real Time Systems
EE 4770
Midterm Examination*

18 March 1994, 8:40-9:30

Problem 1	_____	(34 pts)
Problem 2	_____	(33 pts)
Problem 3	_____	(33 pts)
Exam Total	_____	(100 pts)

Alias _____

Good Luck!

The wording of the questions on this exam may have been modified so that they are consistant with terminology used this semester.

Problem 1: Design a circuit and software to measure temperature using the components described below. (This will be similar to homework 2, problem 1.) The circuit should convert temperature from -20 to 10 °C to a floating point number, `tee`, the temperature in degrees Celsius. (34 pts)

- The circuit should use two RTDs which should be connected in a Wheatstone bridge for maximum sensitivity. Use the linear RTD model with $R_0 = 100\,\Omega$, the resistance of the RTD at 0 °C, and $\alpha_1 = 0.00392\,\frac{1}{^\circ\mathrm{C}}$. Use two-wire RTDs.
- Use an 8-bit analog to digital converter (ADC), which converts its input, v_i, to the integer $\left\lfloor \frac{255}{5}\frac{v_i}{\mathrm{V}} \right\rfloor$. Make full use of the ADC's dynamic range.
- Show the power supply voltage to the bridge, amplifier gain, and the values of any other supplies and components.
- Give an expression for v_i, the input to the analog to digital converter.
- *Taking into account the non-linear response of the bridge,* describe an algorithm which converts the ADC output into `tee`.

Problem 2: Design a circuit which converts irradiance to voltage so that the circuit's output is $v_o = 3H \frac{\text{cm}^2}{\text{mW}}\,\text{V}$. Use a photomultiplier with sensitivity $K_s = 1 \frac{\mu\text{A}\,\text{cm}^2}{\text{W}}$ and dynode gain $A_s = 2$. Do not use a resistor larger than $1\,\text{M}\Omega$. Include a protection diode in your circuit. (33 pts)

Problem 3: Answer each of the problems below. Be brief; correct but lengthy answers will not receive full credit.

(a) What is the difference between repeatability error and stability error? (11 pts)

(b) The irradiance at a point 53 cm from a light source is 7.48 $\frac{\text{mW}}{\text{cm}^2}$. Assuming the source radiates uniformly in all directions, find the radiant intensity at a point 47 cm from the source. (11 pts)

(c) Explain why an RTD and why a thermistor change resistance with temperature. (11 pts)