Name ______________________________

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EE 4770
Мидтерм Ешаминатион

17 March 1999, 8:40-9:30 CST
(Real Time Computing Systems Midterm Examination)

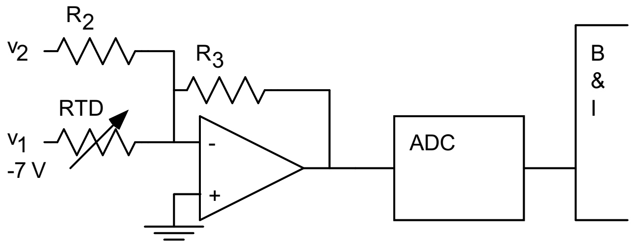
Problem 1	________	(50 pts)
Problem 2	________	(50 pts)
Exam Total	________	(100 pts)

Alias ______________________________

Good Luck!

Problem 1: The partially designed circuit below is to be used to convert temperature $x \in [-20\,°\mathrm{C}, 40\,°\mathrm{C}]$ to a floating-point number $H(x) = x/\,\mathrm{K}$ to be written into variable `temp`. The circuit uses an RTD, its model function is $H_{\mathrm{t1}}(x) = R_0(1+\alpha_1 x)$, where $R_0 = 100\,\Omega$ and $\alpha_1 = 0.00398/\,°\mathrm{C}$. The RTD is connected to a $-7\,\mathrm{V}$ source as shown. The ADC response is $H_{\mathrm{ADC}(10\,\mathrm{V},16\mathrm{b})}$.

(*a*) Complete the design (choose values for v_2, R_2 and R_3), so that the ADC input is in $[0.5\,\mathrm{V}, 9.5\,\mathrm{V}]$ over the range of temperatures to be measured. (20 pts)(For **reduced** credit [$<$ 20 pts] make full use of the ADC dynamic range.)



(b) Write the interface routine. (20 pts)

```
double v1 = -7.0; /* Volts */
double v2 =  /* No need to copy in values from previous page. */
double R2 =
double R3 =
double vadc = 10.0; /* Volts */
double nadc = 65535; /* Quantization levels */
double al1 = 0.00398; /* / Degrees C */
double R0 = 100.0; /* Ohms */

int r = readInterface();
```

```
temp =
```

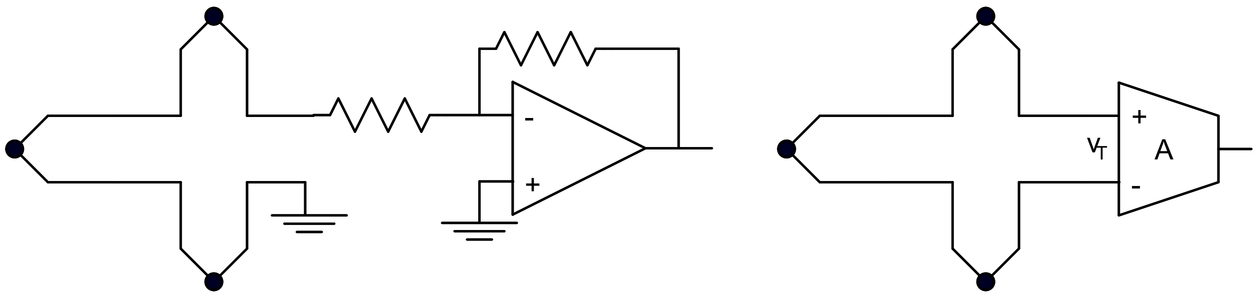
(c) Determine the precision of the temperature measurement. The answer may be given as a formula using $H_{\mathrm{f}}(r)$, the mapping from ADC output to temperature in Kelvins. (10 pts)

Problem 2: Answer each question below.

(*a*) Describe how a photomultiplier works and how it is connected to a conditioning circuit. Name an advantage and disadvantage over a photodiode. (10 pts)

(*b*) A programmer has the option of writing a program that runs as multiple tasks or writing it to run as one multithreaded task. Name two advantages of writing it as a single multithreaded task. (10 pts)

(*c*) Describe a problem with the circuit on the left that does not occur with the circuit on the right. Explain how the circuit on the right avoids the problem. (10 pts)



(*d*) Explain how a magnetic reluctance proximity sensor works. Under what conditions could it be used to measure the speed of a single object? (10 pts)

(*e*) Why is a gray code used in absolute coded displacement transducers? (10 pts)