

Name _____

Реал Тиме Цомпутинг Системс

ЕЕ 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)

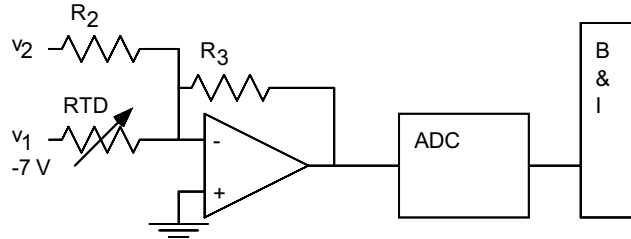
Alias _____

Exam Total _____ (100 pts)

Good Luck!

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

(a) Complete the design (choose values for v_2 , R_2 and R_3), so that the ADC input is in $[0.5\ \text{V}, 9.5\ \text{V}]$ 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 a11 = 0.00398; /* / Degrees C */
double R0 = 100.0; /* Ohms */

int r = readInterface();
```

temp =

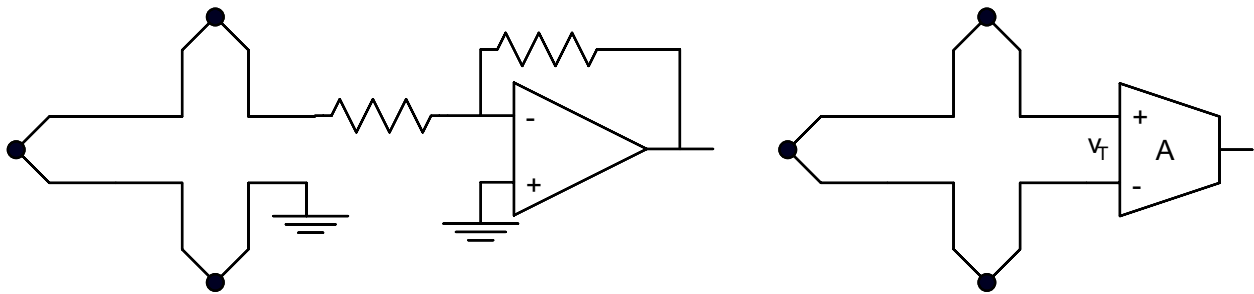
(c) Determine the precision of the temperature measurement. The answer may be given as a formula using $H_f(r)$, the mapping from ADC output to temperature in Kelvins. (10 pts)

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)