CS 3468 – Homework 2

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September 22, 2014

Chapter 3

2a. (Please use the schematic symbols on page 594)

12.

19.

20. (Describe what these ICs are)

Additional Questions

The resistance of a thermistor changes according to the temperature. In the right circuit, the resistance function of the thermistor is $R_0 = 10\,000\,\Omega + 60\,\Omega\,^\circ\mathrm{F}^{-1} \cdot T$. The other resistor is $R_1 = 10\,000\,\Omega$. The output voltage on R_1 is $V_0 = 3\,\mathrm{V} \cdot \frac{R_1}{R_0+R_1}$.

a If the room temperature is $T = 70\,^\circ\mathrm{F}$, what is V_0?

$$
\begin{aligned}
V_0 &= 3\,\mathrm{V} \cdot \frac{R_1}{R_0 + R_1} \\
&= 3\,\mathrm{V} \cdot \frac{10\,000\,\Omega}{R_0 + 10\,000\,\Omega} \\
&= 3\,\mathrm{V} \cdot \frac{10\,000\,\Omega}{(10\,000\,\Omega + 60\,\Omega\,^\circ\mathrm{F}^{-1} \cdot T) + 10\,000\,\Omega} \\
&= 3\,\mathrm{V} \cdot \frac{10\,000\,\Omega}{(10\,000\,\Omega + 60\,\Omega\,^\circ\mathrm{F}^{-1} \cdot 70\,^\circ\mathrm{F}) + 10\,000\,\Omega} \\
&= 3\,\mathrm{V} \cdot \frac{10\,000\,\Omega}{(10\,000\,\Omega + 4200\,\Omega) + 10\,000\,\Omega} \\
&= 3\,\mathrm{V} \cdot \frac{10\,000\,\Omega}{14\,200\,\Omega + 10\,000\,\Omega} \\
&= 3\,\mathrm{V} \cdot \frac{10\,000\,\Omega}{24\,200\,\Omega} \\
&= \frac{30\,000}{24\,200}\,\mathrm{V} \\
&\approx \boxed{1.24\,\mathrm{V}}
\end{aligned}
$$

b If $V_0 = 1.339\,\mathrm{V}$, what is the room temperature?

$$
\begin{aligned}
V_0 &= 3\,\mathrm{V} \cdot \frac{R_1}{R_0 + R_1} \\
1.339\,\mathrm{V} &= 3\,\mathrm{V} \cdot \frac{10\,000\,\Omega}{(10\,000\,\Omega + 60\,\Omega\,^\circ\mathrm{F}^{-1} \cdot T) + 10\,000\,\Omega} \\
\frac{1.339}{30\,000} &= \frac{1\,\Omega}{(10\,000\,\Omega + 60\,\Omega\,^\circ\mathrm{F}^{-1} \cdot T) + 10\,000\,\Omega} \\
\frac{30\,000}{1.339} &= \frac{(10\,000\,\Omega + 60\,\Omega\,^\circ\mathrm{F}^{-1} \cdot T) + 10\,000\,\Omega}{1\,\Omega} \\
&= \frac{20\,000\,\Omega + 60\,\Omega\,^\circ\mathrm{F}^{-1} \cdot T}{1\,\Omega} \\
&= 20\,000 + 60\,^\circ\mathrm{F}^{-1} \cdot T \\
\frac{30\,000}{1.339} - 20\,000 &= 60\,^\circ\mathrm{F}^{-1} \cdot T \\
T &= \frac{\frac{30\,000}{1.339} - 20\,000}{60}\,^\circ\mathrm{F} \\
&\approx \boxed{40.1\,^\circ\mathrm{F}}
\end{aligned}
$$