6.302 Lab 1B Report

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1. The prelab indicated that I would see a time constant of $\tau = 25$ ms, but since $t_r = 2.2\tau$, this corresponds to a rise time of $t_r = 55$ ms. In the lab, I measured a rise time of $t_r = 34$ ms. The two values are close, but not identical. I observed that an input drive of 1.35 Volts is sufficient to saturate the system.

2. I measured a 3 dB frequency of $f = 4.46$ Hz. Since at the 3 dB point, $|\frac{1}{\tau s+1}| = \frac{1}{\sqrt{2}}$, we know that $\omega = \frac{1}{\tau}$. But since $\omega = 2\pi f$, $f = \frac{1}{2\pi\tau}$. For the measured value of $t_r = 34$ ms, we should see a time constant of $\tau = 15$ ms and a 3 dB frequency of $f = 4.68$ Hz, which is very close to the $f = 4.46$ Hz frequency I measured.

3. I measured a steady state error of -0.609 Volts.

4. I measured a steady state error of -0.738 Volts. The proportional plus integral controller produces a slightly higher steady state error than the proportional controller.

5. I measured a rise time of $t_r = 45$ ms, a 3 dB frequency of $f = 7.12$ Hz, and a steady state error of -0.667 Volts. With a current drive, the system is slower to respond (has a longer rise time) but has a larger bandwidth (the 3 dB point is further out). The steady state error is slightly higher for the current drive. This is very surprising since I expected zero steady state error for the current drive.