Objective The objective of this lab is to fit a voltage-to-position transfer function for a small DC motor using basic system identification techniques.

In class, we applied a 12V chirp (swept sinewave) signal to the motor, with a starting frequency of 0.1 Hz and an ending frequency of 10 Hz. The frequency sweep was linear in time, with a duration of 10 seconds. We collected the input voltage (u), the shaft position in radians (θ), the shaft velocity in radians per second (ω) and the time (t). Data was collected at 1 millisecond intervals.

The data was saved as Matlab file chirpEMG30_RT.mat and has been posted to the course website. Do the following:

1. Plot the data (input, velocity and position)
2. Import the voltage and the velocity into the system identification toolbox. Remove means and filter as necessary. Since we sampled at 1kHz, the rule-of-thumb indicates that we should limit the frequency of our data (and the bandwidth of the resulting model) to 1/5 of the sampling frequency.
3. Use the system identification toolbox functions to obtain a discrete transfer function that achieves a good prediction score (at least 75%).
4. Export the transfer function and convert it to continuous time. Examine the location of zeroes and poles and remove any roots that have small time constants (use the pole dominance criterion learned in MCE441). Remember to adjust for scaling (G(0)).
5. Manually add an integrator to the velocity transfer function to obtain a position transfer function.
6. Prepare a Simulink diagram where a chirp input with the same characteristics as the experimental input is applied to the position and velocity transfer functions. Plot the outputs and compare them with the experimental ones.
7. Comment on the position drift observed in the experiment in comparison with the simulation results. What changes would you introduce in the position transfer function so that the same drift appears in the simulation?

Reporting
Document the whole process in your lab notebook. You may paste plots or keep them organized in a separate binder for easy reference.