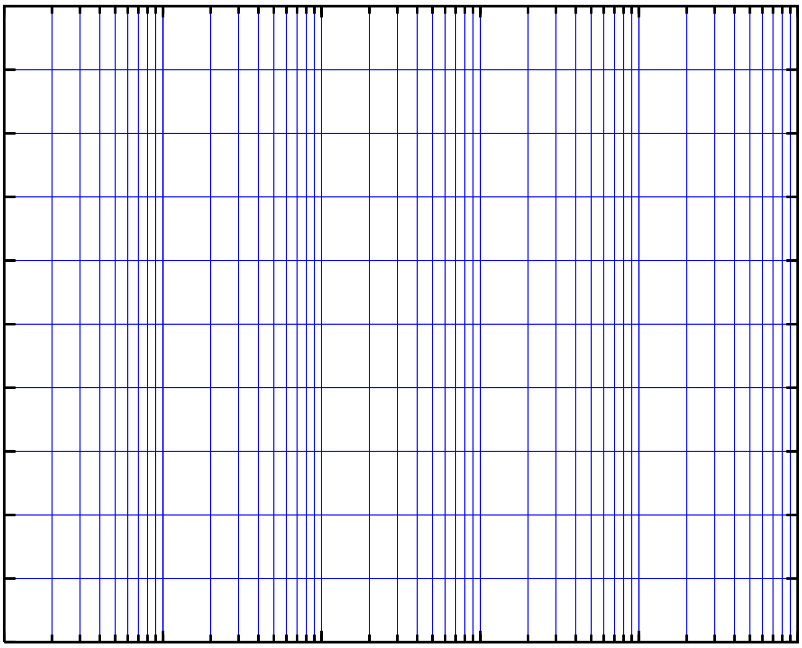
EE380 (Control Systems) Solution to Pre-Lab work of Experiment 2

Student Name	Roll No.	Bench No.

Q1 Write down the identified mathematical model you used in Experiment 1.

Q2 In the lab, we will apply a sinusoidal voltage from a function generator (FG) to the dsPIC micro-controller's analog input. We will want the motor's speed to track this sinusoidal input.

Design using loop-shaping, a controller of first order such that the closed-loop system will track sinusoids of frequencies upto 7 Hz with $e_{ss} \leq 2\%$ (in magnitude). For the settling time (defined as "time to enter the $x\%$ tube with the intention of remaining in it") do the best you can achieve, given the other specifications, and given that the imperfections of the plant are what they are. *Hint: See EE250 lecture notes for a solution to this problem.*



Q4 Discretize the continuous-time controller using Euler's approximation. Use `tf2ss`.

Q5 With the discretized version, perform a simulation of digital control of the continuous-time plant using the m-file `simsine.m`. Apply reference sinusoids of magnitude = 150 rad/s, and about 4 frequencies (in Hz): 1, 3, 5, 7. You may need to slightly modify `simsine.m` to suit your purpose. Populate the following table.

Frequency of reference sinusoid of amplitude 150 rad/s [Hz]	1	3	5	7
Amplitude of rotor speed ω in CL [rad/s]				
Amplitude of control u [V]				

If the desired performance is not achieved, then repeat Q2 onwards. Else, proceed to Q6.

In the lab, observe the frequencies up to which tracking happens well.

Q6 Write the digital controller in C.

Q7 SYSTEM IDENTIFICATION USING LSE: Supply various values to K, a, b in the file `sysid.m`, execute this file in GNU Octave, and compare the resulting values of K, a, b with the supplied values. Do you think that `sysid.m` is doing a good job of estimating the supplied values?

	K	a	b	K	a	b	K	a	b
To `sysid.m`									
From `sysid.m`									

Q8 Assume that the plant TF obtained in Experiment 1 is $32.286/(0.052s+1)$.

A voltage waveform is applied to the open-loop system from a function generator. Three sets of $u - \omega$ data are obtained into files named `tri4fg5.log`, `tri8fg5.log`, and `rect4fg5.log`. These data correspond respectively to trianglular waveform of $u \approx 4$ V amplitude, triangular waveform of $u \approx 8$ V amplitude, and rectangular waveform of $u \approx 4$ V amplitude.

To see the effect of the deadzone, plot the contents of each of the `.log` files using `readplot.m`, and sketch your results below.

ω vs. t and u vs. t from `tri4fg5.log`	ω vs. t and u vs. t from `tri8fg5.log`	ω vs. t and u vs. t from `rect4fg5.log`

Then, use the attached file `readSID.m`, which is an amalgam of `readplot.m` and `sysid.m`, to populate the following table.

Type of TF	TF	Parameters of step response	
		$\omega(\infty)$ [rad/s]	Sketch of step responses (all in one) (unfiltered ones)
TF from Exp-t 1			
TF from triangle of 4 V amplitude			
TF from triangle of 8 V amplitude			
TF from rectangle of 4 V amplitude			