ME 360: FUNDAMENTALS OF SIGNAL PROCESSING, INSTRUMENTATION, AND CONTROL

Experiment No. 4
Modeling and Identification of an Electric Motor using Step Response Methods
Pre-lab Questions

These short answer questions must be completed and turned in at the beginning of the laboratory period.

1. a. Using the following data in a MATLAB script, plot the expected step response of the motor-generator system. (5 pts)

Steady state gain K	1.2
Time constant τ	50 ms
Initial output voltage V_o	0 V
Final input voltage V_{in} (∞)	4 V
Starting time t_o	0 s
Ending time t_f	0.5 s

b. On the step response plot from above, draw a tangent line at t = 0, and determine the intersection of this line with the long-time asymptote. (5 pts)

c. Using the step response plot from above, determine the time at which the voltage change reaches 63.2% of its maximum value. Mark this point on the plot. (5 pts)

d. Explain mathematically why τ is found at this 63.2% point. (5 pts)

2. See Appendix C Method 3. Show that (6 pts)

$$\tau = \int_0^\infty \left[1 - \frac{V_{out}(t)}{V_{out}(\infty)}\right] dt$$

with our first order system that has the equation

$$V_{out}(t) = V_{out}(\infty)\,[\,1 - \exp(-t/\tau)\,]$$

3. Variation in K as a function of input voltage demonstrates what about our model? (2 pts)

4. List the four methods used to calculate τ in this lab. (2 pts)