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. On a separate sheet and using the following data, plot the expected step response of the motor-generator system.

Steady state gain K	1.2
Time constant τ	50 ms
Initial output voltage V_o	0 V
Final input voltage $V_{in}(\infty)$	4 V
Starting time t_o	0 s
Ending time t_f	3 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.

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.

d. Explain mathematically why τ is found at this 63.2% point.

2. See Appendix C Method 3. Show that

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

with our first order system that has the equation

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

3. Variation in K demonstrates what about our model?

4. List the methods used to calculate τ in this lab.