Every lab in controls should be written up with a lab report for each team working on an experiment. The lab reports are due the week after the lab is completed. So the first lab report should be turned in at the first of the third week, since the first lab is a two-week lab. Even though the lab report is a shared responsibility, each member of the lab team is responsible for every action taken during the lab and everything that appears in the lab report. Your knowledge of each lab is tested during the lab final, which counts 35% of your lab grade.

The overriding feature of your laboratory reports is to provide a complete yet concise description of your activities in the lab. There is no need for a long-winded account of the technical background behind the lab. I am interested primarily in results and how you got them.

Your lab report should include the following sections:

1. Results – Yes, give the results up front. Tell whether your modeling succeeded in capturing the dynamics of the plant effectively.

2. System Modeling – Detail the testing that you did to model each component in the physical system you worked with. Briefly describe each test, tell what physical constants you are seeking, and give the resulting constants along with the appropriate physical units. Graphs that result from your tests should be referred to and attached in an appendix.

   At the end of this section you should have a Table of System Parameters. In this table you will have four columns: Name, Symbol, Value, Units. For each parameter, fill in these columns. For instance for a DC servo motor, you might write: Motor time constant, $T_m$, 0.586, sec. Make sure your table includes every parameter needed to model the system. An incomplete table will count against you. For your symbols, use those given in the lab description, not some you made up yourself.

3. System Model – Give the overall system model block diagram. On each signal line on the model, note that signal’s units (volts, in/sec, etc.). These annotations can be put on the block diagram by hand if you like, but do it neatly.

4. Model Fidelity – Model fidelity is a fancy way to say how well your model’s behavior duplicates that of the real system when both are subjected to the same input. For example, your model’s response might match that of the real system in that they have the same overshoot. But they may not match in peak time. So the matching or lack thereof for each response feature should be enumerated.

   If there is a mismatch in response output, you should go back and try to tune your model to get a better match. This might be an iterative process in which you tweak your model and then test it again. You should not just do random tweaking. I.e. your
model modifications should be reasoned ones. For example you might change a certain parameter because you want to affect peak time without affecting overshoot, and that parameter affects the peak time but not the overshoot.

The central piece to this section is the System Response Plot. This is a graph of output as a function of time. This will be the output from your Simulink model. If you tune your model iteratively, you should show the changed response for each modification of the model. It should be clear on the plot which response goes with which version of the model. Annotation to show this can be put on the plot by hand if it is done neatly.

*It is required that this plot should also contain on it the real system response.* This is NOT to be provided on a separate graph. It needs to be on the actual Simulink response plot to facilitate comparing the real and simulated responses. The appendix and course website provide information that shows how to get the real system response into Matlab-readable format.

5. System Dynamic Characteristics – From the tuned model you should be able to conclude various things about the physical system. If the response of the system is oscillatory, then the system can be characterized as a (dominant) second-order, underdamped system. Second order systems have three system parameters—\( K_{ss}, \xi, \) and \( \zeta_n \). In this section you report these values (with units). You should also work out algebraic expressions for these in terms of system physical characteristics (gains, diameters, time constants, etc.).

6. You may have another section for anything important to the experiment that is not included above, for example system root locus, stability analysis, etc., if these results are required.

7. Appendices – Clearly label these with appropriate titles.

There are a couple of fatal grammatical/spelling mistakes that you should not commit. First, it is your obligation to thoroughly proofread your report. Misspelled words that could have been found with a spell checker are unacceptable and will count severely against you. Second, do not use contractions in your report. So say “do not”, not “don’t”.