CM3310 Project 2.
Due: February 29, 2005

1. **PID Controller Tuning**

   a. Using the process "SYSTEM A" simulated through the link, http://www.chem.mtu.edu/~tbco/cm416/newpida.html, apply the following tuning methods:
      i) Ziegler-Nichols Method
      ii) Autotune Relay Test with Tyreus-Luyben Method
      iii) Cohen-Coon Method

      Submit the plots used for the determination of the controller parameters, as well the final controlled process, for each method.

   b. Using the process "SYSTEM B" simulated through the link, http://www.chem.mtu.edu/~tbco/cm416/newpidb.html, apply the tuning methods of Autotune Relay Test with Tyreus-Luyben Method. Submit the plots used for the determination of the controller parameters, as well the final controlled process. (Note: System B is an inverse-response process with negative process gain.)

2. **Process Modeling**
   a. Using the process from SYSTEM B (http://www.chem.mtu.edu/~tbco/cm416/newpidb.html), collect the data using the procedures outlined in Appendix A.
   b. Use the Excel spreadsheet (with SOLVER) to estimate a second order model that would closely fit the data obtained from the previous step. For a quick tutorial using Euler method, go to http://www.chem.mtu.edu/~tbco/cm416/modest.html . (*Note that the example in the tutorial is for a third order model while your desired model is second order. Also, for a second order model, stability is guaranteed as long as a_0, a_1 and a_2 are all positive, so you can use this fact when setting your constraints in* SOLVER).
   c. Report the model obtained and show the plots of the data together with the predicted/estimated values.

3. **Optimizing Controller Tuning** (Optional. Bonus: +20pts)
   a. Using the model obtained from part 2, simulate the process in Excel using Euler method while including a PI controller.
   b. Use SOLVER to optimize the controller tuning based on minimizing ISE (integrated square error = $\int_0^T e^2 dt$).
   c. Run "SYSTEM B" once more but use the PI control parameters found.

Appendix A. Data Gathering for System B

1. Under manual mode, set the input to 0.0 and wait for steady state.
2. Invoke a step change in the input to 1.0
3. After around 50 time units elapse, invoke an opposite step change in the input to 0.0
4. After approximately 45 time units elapse, click on the PAUSE button. (You will need a flat portion on the front of your output plot as shown below.)

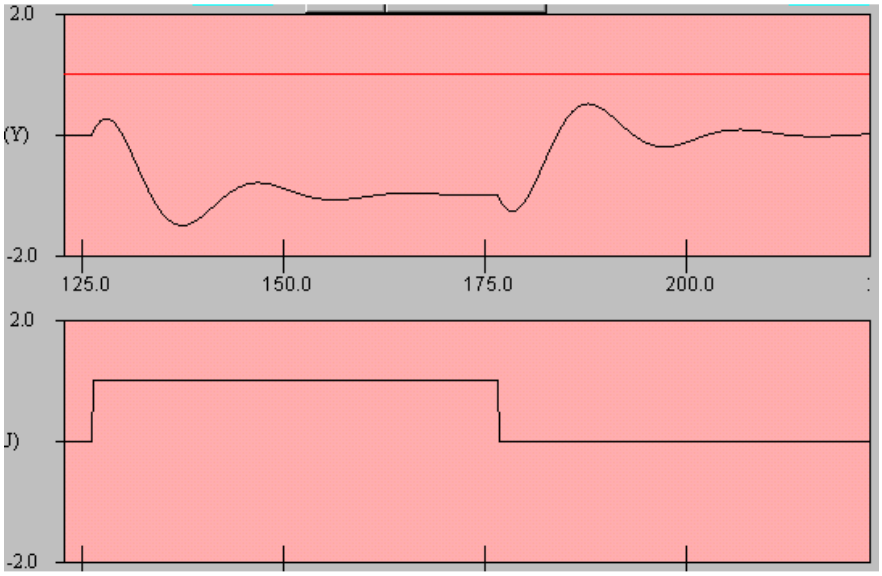

Figure 1.

5. Click the DATA button and the data window should appear.
6. Inside the data window, right click on your mouse to the SELECT ALL option. (If you are using Internet Explorer, you need to select the block of data by click-dragging the mouse. Then use CTRL-C to copy and CTRL-V to paste data into Excel)
7. Right click on your mouse to COPY to the clipboard.
8. Open an Excel spreadsheet and PASTE the contents from the clipboard.