Chemical Engineering 436
Special Problem #2

Objective: To introduce you to the *MATLAB / Simulink* Software and to prepare you for our discussion on process dynamics.

a) **Get access to the MATLAB software.** This can be done by logging in to one of the UO Lab computers and looking either in the RGS system or in the Math Programs section.

b) **Get acquainted with the software.**
   1) Watch the donkey cart control problem video (http://goo.gl/kWbhlw) and replicate the manual and automatic control loops. Run the simulations and compare the results as shown in the video. With the manual simulation, the manipulated variable (switches / min) can be changed manually and the response of the system to this change can be observed. Try this by putting in a step and another input function like sine wave. If you cannot find the step function or other function, use the search bar at the top. Input blocks are also listed as the **Source** category in the menu on the left**.** How did the donkey cart respond?
   2) Experiment with the program. Try saving data to a file, running for different amount of time, adding a disturbance, changing input values, etc.

c) **Briefly explore the dynamic behavior.**
   1) Donkey cart control
      a) Please identify the controlled variable, manipulated variable, and a potential disturbance variable.
      b) In manual control (only the input function, donkey cart transfer function, and scope), change the manipulated variable to 10 switches/min. Record the final value for the velocity (m/s).
      c) Change the manipulated variable to 15 switches/min and observe the response. Record the final value of the velocity and approximately how long (sec) it took to arrive to steady state (within ~5% of final value) after the change.
      d) Calculate the change (m/s) in the controlled variable caused by an increase of 5 in the value of the manipulated variable from the gain ($K_p = \Delta y / \Delta u$ = *change in controlled variable / change in manipulated variable*). Compare this value with the difference between part *c* and part *b*. (Hint: do not change the process gain. The process gain is an attribute of the system and in this case the donkey's response to the switching rate does not change just by changing the input switching rate.)

d) **Draw a block diagram for the donkey cart problem and label all of the signals (connections).**