EECE 360 Homework - Feedback Systems

1) A normalized first order system has the following characteristics:
   - a pole at -2.

   a. Design a feedback controller so the system transfer function has a time constant of 0.25 and unity gain.

   b. Modify the controller so that the system has a DC gain of 2.

   c. Implement the system using Simulink and plot the open loop step response and the closed loop step response for both of your controllers.

2) A first order system has the following characteristics:
   - a pole at -5.
   - a DC offset.
   - a final value of 7.
   - the system input is a voltage and the output is a position in cm.
   - the position sensor measures the position in inches and outputs 5 V/in.
   - the feedback control system should have a DC gain of 1 V/cm.
   - note: 1cm = 0.4 in

   a. What feedback gain must be applied for unity feedback?

   b. Implement the system using Simulink and plot the closed loop step response when the controller has a forward gain of 3.

   c. Is the closed loop system first order or second order?

3) An overdamped second order system has the following characteristics:
   - a natural frequency of 2 rad/s.
   - a damping coefficient of 2.
   - a DC gain of 0.5.
   - no zeros.

   a. Implement a unity gain feedback controller using Simulink and plot the closed loop step response. Experimentally find the controller gain which results in critical damping.

   b. Check your result mathematically.