This tutorial provides some practice for the next midterm, and makes sure you understand some concepts from this week’s classes.

**Question 1**

*From a previous midterm*

1. For the process transfer function \( G_p(s) = \frac{5}{(s+1)(2s+1)} \): is it overdamped, underdamped, or critically damped? ______________________

2. For the same process transfer function: what are the roots?

3. Write out an analytical transfer function for the closed loop response, \( \frac{y(s)}{y_{set}(s)} \).
4. Determine the amount of offset at steady-state for a step input of 2 units in the set point. (You must do the calculations by hand, not with Simulink).

5. Describe what the time-domain characteristics of the closed-loop response will be: overdamped, critically damped, underdamped? And what will be the roots of the closed loop transfer function, \( \frac{y(s)}{y_{set}(s)} \) ?

**Question 2**

*Challenge for extra credit [double your tutorial grade for today].* Calculate the controller tuning settings \((K_c, T_I, T_D)\) for a PID controller that controls a process that may be approximated by the following transfer function, \( G_p = \frac{-4e^{-5s}}{3s + 1} \). Explain clearly why the controller gain, \( K_c \) is negative.

Now set the derivative mode, \( T_D = 0 \), then show what the final value of the controlled variable will be for a step change of 2 units in the set point. *Submit answers on a separate page.*