Process Control, 3P4 Your name: ____________

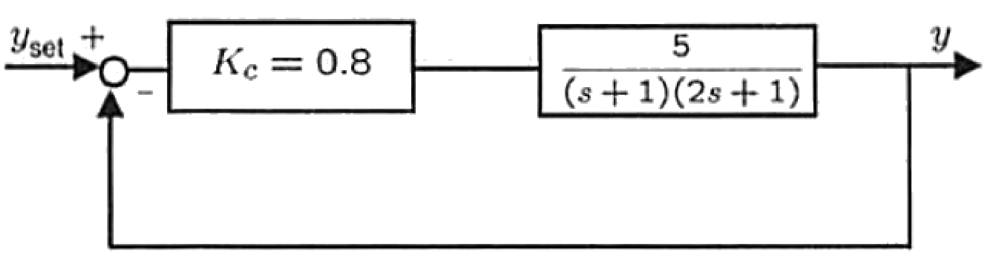
Tutorial 7 - Friday Student number: ____________

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 $G_p(s) = \dfrac{5}{(s+1)(2s+1)}$: 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, $\dfrac{y(s)}{y_{\text{set}}(s)}$.



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, $\dfrac{y(s)}{y_{\text{set}}(s)}$?

Question 2

Challenge for extra credit [double your tutorial grade for today]. Derive the closed-loop transfer function, from the set point to the controlled variable, $\dfrac{\text{CV}(s)}{\text{SP}(s)}$ for the process $G_p(s) = \dfrac{K_p}{s}$ (this is a model of a tank's height when varying the input flow - *prove it to yourself*).

Let the controller be $G_c(s) = K_c$, a proportional-only controller. We learned in class that P-only control has offset (never reaches the set point). However, prove mathematically that for this process there is **no offset** when making a step change in the set point, $\text{SP}(s) = \dfrac{M}{s}$. Can you explain why? Show your calculations on a separate page and hand it in by the end of the tutorial today.