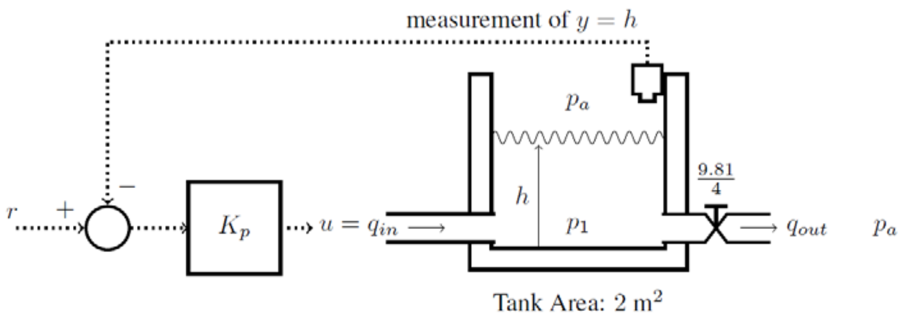
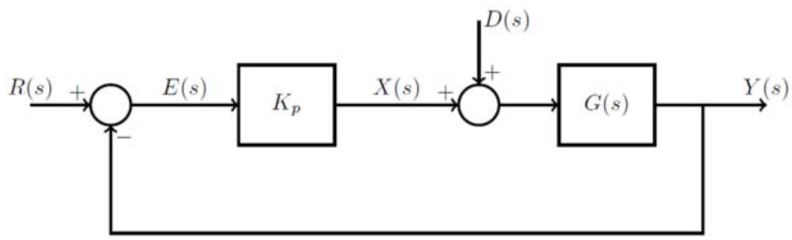
EENG307: Introduction to PID Control (Lecture 19)

PID Control Example: Proportional Control of a Water Tank

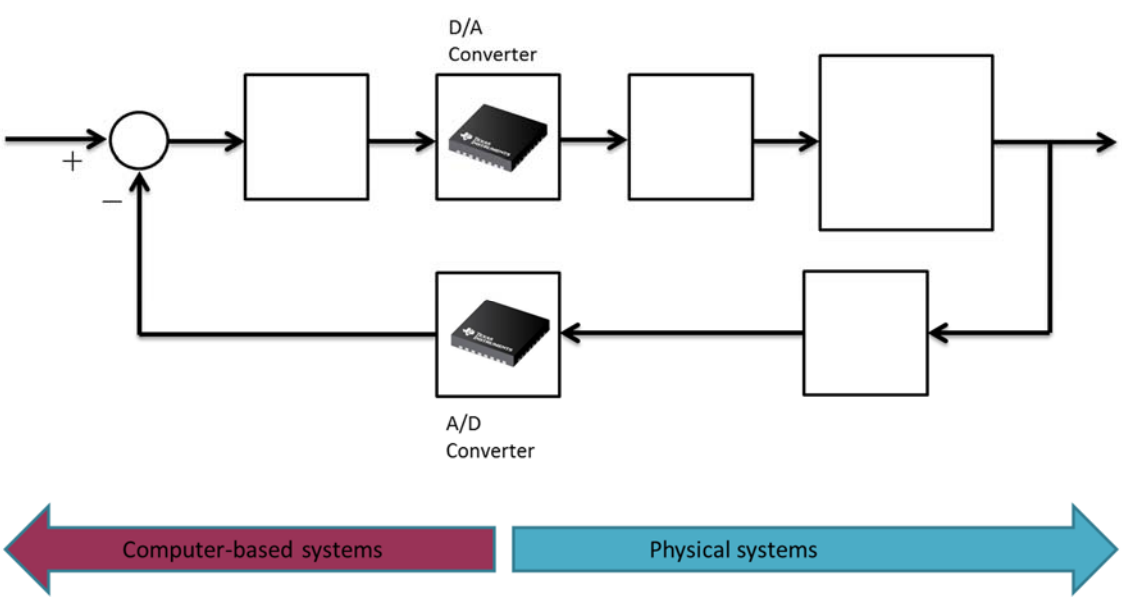
The design of a proportional controller (K_p) to control the height h of water in a tank to reach and remain at a desired reference height r is motivated in Lecture 19 by the following diagram:



with symbolic representation



To implement this controller, some systems (blocks) and signals (arrows) are physical elements and others occur digitally within a computer. Conversion between the two is done with digital-to-analog (D/A) and analog-to-digital (A/D) converters. Label the systems and symbols in the diagram below:



PID Control Example 2: Design Steps

Use the steps in the left column below to work Example 4 in Lecture 19.

Step	Example 4
1: Collect design specifications Transient: t_r, t_s, $\%OS$ Steady-state: final values (y_{ss}, e_{ss}) with respect to reference and/or disturbance input	
1.5: Select a controller type Proportional (P): $C(s) = K_P$ Proportional-derivative (PD): $C(s) = K_P + K_D s$ Proportional-integral (PI): $C(s) = K_P + \frac{K_I}{s}$ PID: $C(s) = K_P + \frac{K_I}{s} + K_D s$	
2: Find all necessary closed-loop transfer functions (depend on design specifications), including plugging in your G(s) and C(s) $\frac{Y(s)}{R(s)} = \frac{C(s)G(s)}{1+C(s)G(s)}$ $\frac{E(s)}{R(s)} = \frac{1}{1+C(s)G(s)}$ $\frac{E(s)}{D(s)} = \frac{-G(s)}{1+C(s)G(s)}$	
3: Translate design specifications into requirements on ω_n, ζ, e_{ss}, and y_{ss}, then match equations to find control gains K_P, K_I, and K_D. (a) find the desired closed-loop transfer function and match to the actual closed-loop transfer function (b) find the actual steady state error or output and match to the desired value	