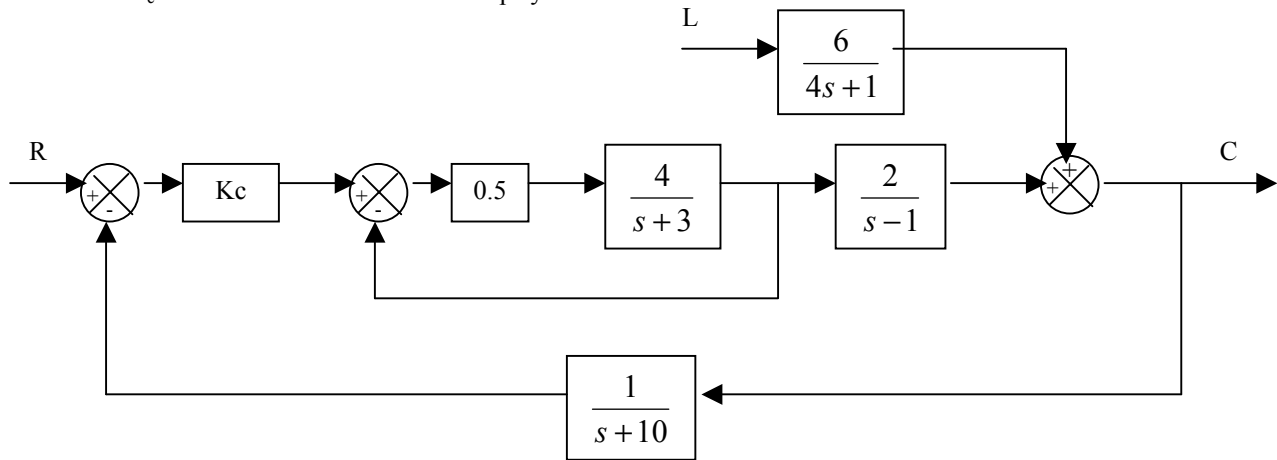


ChEE 413
Homework Handout 9
Spring 2005

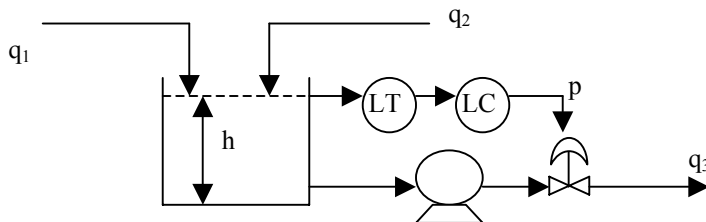
1) Problem 11.1 from first edition - A PI controller is to be used in a temperature control loop. For nominal conditions, it has been determined that the closed loop system is stable when $\tau_1 = 10$ min and $-10 < K_c < 0$. Would you expect these stability limits to change for any of the following instrumentation changes? Justify your answers using qualitative arguments:

- a) The span on the temperature transmitter is reduced from 40 to 20 °C.
- b) The zero on the temperature transmitter is increased from 110 to 130 °C.
- c) This one is not assigned.

2) Problem 11.2 from first edition - Using the following block diagram of a feedback control system, determine the values of K_c that result in a stable closed-loop system:



3) Problem 11.4 from first edition - Use the following diagram:



Liquid level control system with a pump in the exit line

Determine the numerical values of K_c and τ_1 that result in a stable closed loop system. The level transmitter has negligible dynamics while the control valve has a time constant of 10 s. The following numerical values are available:

$A = 3 \text{ ft}^2$, $\bar{q}_3 = 10 \text{ gal/min}$ $K_v = -1.3 \text{ gal/min/mA}$ (for control valve) and $K_m = 4 \text{ mA/ft}$ (for the level transmitter).