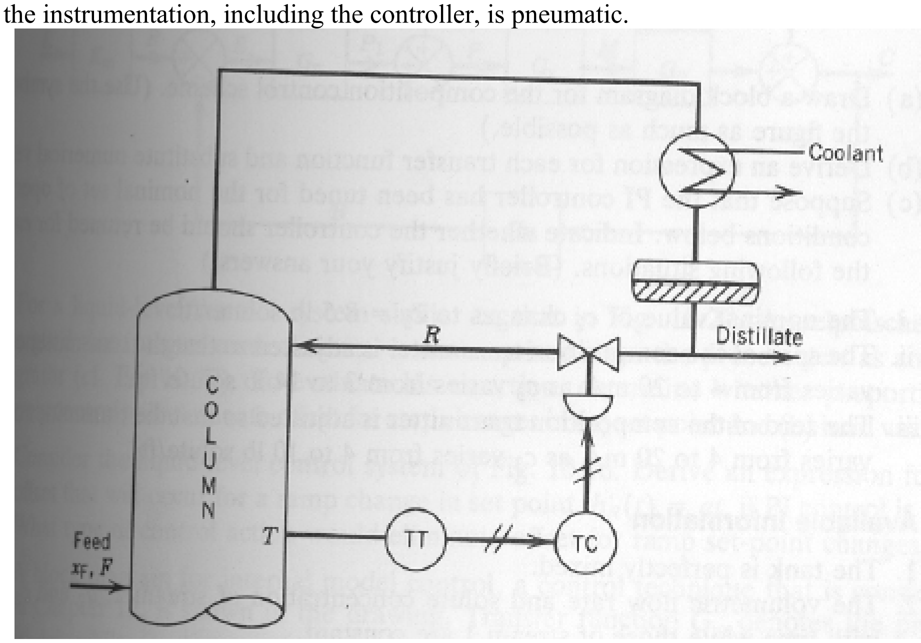
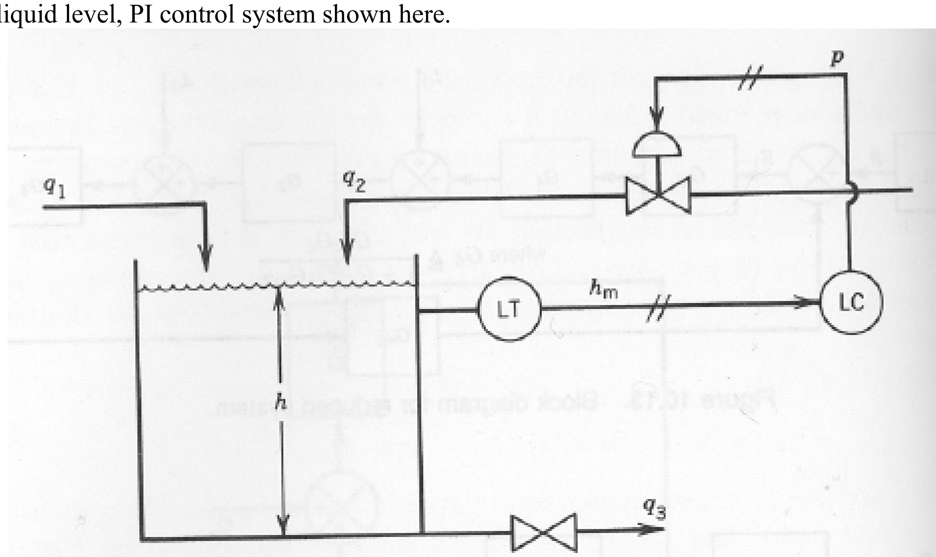
ChEE 413
Fall 2005
Homework Handout 7

1) Solve problem 9.1 in your book, but do not do the parts for the Concentration Example

2) Problem 10.1 in First Edition -
A temperature control system for a distillation column is shown schematically in the drawing. The temperature T of a plate near the top of the column is controlled by adjusting the reflux rate R. Draw a block diagram for this feedback control system. You may assume that both feed flow rate F and feed composition x_f are load variatbles and that all of the instrumentation, including the controller, is pneumatic.



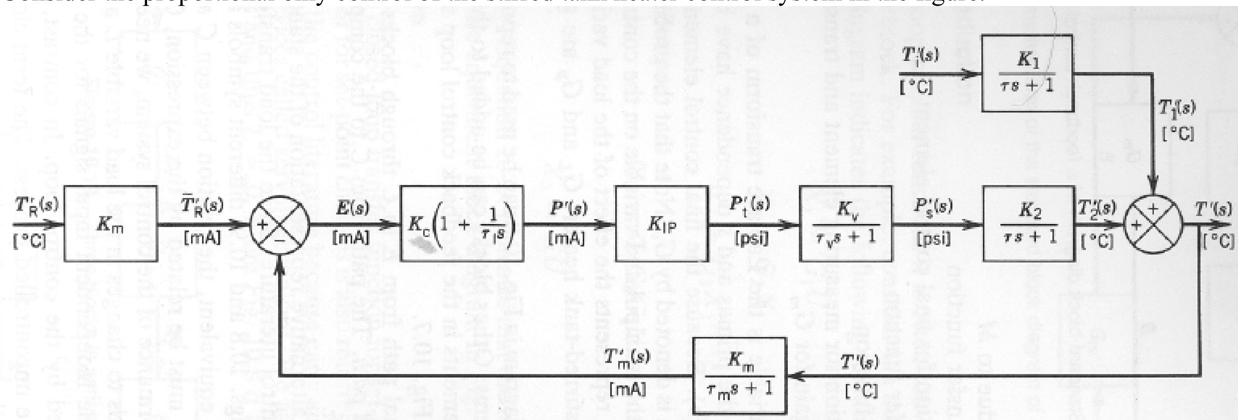
3) Problem 10.2 in First Edition -
Consider the liquid level, PI control system shown here.



The following parameters are valid: A = 3 ft^2, R = 1.0 min/ft^2, K_v = 0.2 cfm/psi, K_m = 1.7 psi/ft, K_c = 4, and τ_i = 3 min. Suppose that the system is initially at the nominal steady state with a liquid level of 2 ft. If the set point is suddenly changed from 2 to 3 ft, how long will it take the system to reach (a) 2.5 ft and, (b) 3 ft?

4) Problem 10.3 in First Edition -

Consider the proportional only control of the stirred tank heater control system in the figure.



The temperature transmitter has a span of 50 °F and a zero of 55 °F. The nominal design conditions are $\overline{T}$ = 80 °F and $\overline{T_i}$ = 65 °F. The controller has a gain of 5 while the gains for the control valve and current-to-pressure transducer are Kv = 1.2 (dimensionless) and KIP = 0.75 psi/mA, respectively. The time constant for the tank is τ = 5 min. After the set point is changed from 80 to 85 °F, the tank temperature eventually reaches a new steady state value of 84.14 °F, which was measured with a highly accurate thermometer.

a) What is the offset?

b) What is the process gain, K_2?

c) What is the pressure signal p_t to the control vavlve at the final steady state?