

King Abdulaziz University

College of Engineering , Chemical Engineering Dept.

Fall 2004 HW#9 Ch.E 442

(Design & Computer Application)

1. Problem IV.23 (c & e) in the textbook (Chemical Process control by G. Stephanopoulos).

2. A first order process is to be controlled with a PI controller. The following information is given:

$$G_p(s) = G_d(s) = 1/(s+3) \quad \text{and} \quad G_m(s) = G_f(s)$$

Select the values of the controller gain k_c and reset time τ_i so that:

- a- The closed-loop gain to load changes is 10.
- b- The decay ratio of the closed-loop response is $1/4$.

3. Select the gain and reset time setting of a PI controller, employing the minimum ISE criterion for a unit step change in the set point. The process is first-order with $K_p = 10$, and $\tau_p = 1.0$. Assume that $G_m(s) = G_f(s) = 1$. The selected settings must satisfy

the restrictions:

$$1 \leq k_c \leq 100 \quad \text{and} \quad 0.1 \leq \tau_i < 10$$

4. Select the gain of a proportional controller using the one-quarter decay ratio criterion. The process is described by:

$$G_p(s) = 10/[(s+2)(2s+1)]$$

Assume $G_m(s) = G_f = 1$.

Also, select the gain using the minimum ISE criterion and a unit step change in the set point. The condition $1 \leq k_c \leq 100$ must be satisfied by the gain values selected. Compare the settings computed by the two methods and explain the difference between them.