دانشگاه علم و صنعت ایران
دانشکده مهندسی مکانیک

بسمه تعالی

تکلیف شماره 8- درس سیستمهای کنترل خطی .... مدرس: دکتر دوایی

مبحث : سیستم های کنترل حلقه بسته (قسمت دوم)

تاریخ تحویل: یک هفته پس از دریافت

1.

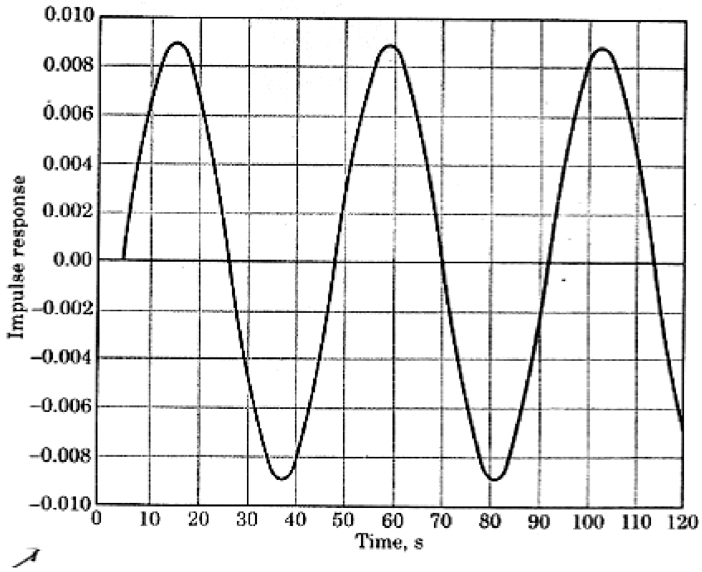
A heat exchanger has the transfer function

$$G(s) = \frac{e^{-5s}}{(10s + 1)(60s + 1)}.$$

a) Find the PID-controller parameters according to the Zeigler-Nichols tuning rules.

b) The system becomes marginally stable for a proportional gain of $K_u = 15.25$ as shown by the unit-impulse response in Fig. 3.26. Find the optimal PID-controller parameters according to the Zeigler-Nichols tuning rules.

FIGURE 3.26



2.

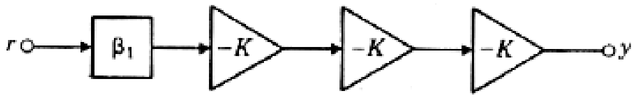
Bode defined the sensitivity function of a transfer function G to one of its parameters k as the ratio of percent change in k to percent change in G. We define the reciprocal of Bode's function as

$$S_k^G = \frac{dG/G}{dk/k} = \frac{d\ln G}{d\ln k} = \frac{k}{G}\frac{dG}{dk}.$$

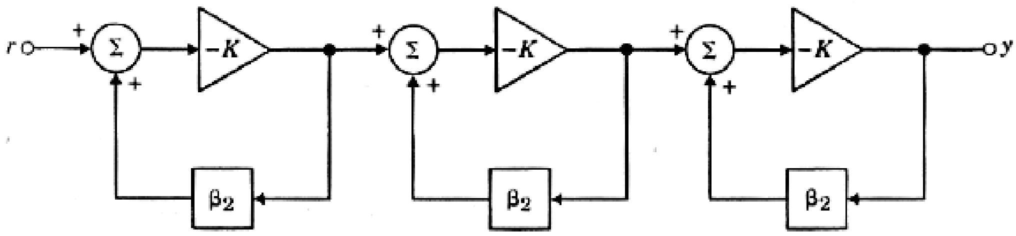
Thus, if the parameter k changes by 1%, S tells us what percent change to expect in G. For control systems, we are almost always interested in zero frequency, or $s = 0$ in sensitivity calculations. The purpose of this exercise is to examine the effect of feedback on sensitivity. In particular, we would like to compare the topologies shown in Fig. 3.23 for connecting three amplifier stages of gain $-K$ each into a single amplifier of gain -10.

a) For each case, compute β_i so that, if $K = 10$, $y = -10r$.
b) For each case, compute S_K^G when $G = y/r$. [Use the respective $\{\beta_i\}$'s found in (a)]. Which case is the *least* sensitive?
c) Compute the sensitivities of Fig. 3.23(b) and (c) to β_2 and β_3. Comment on the relative requirements for precision in sensors and actuators from these cases.

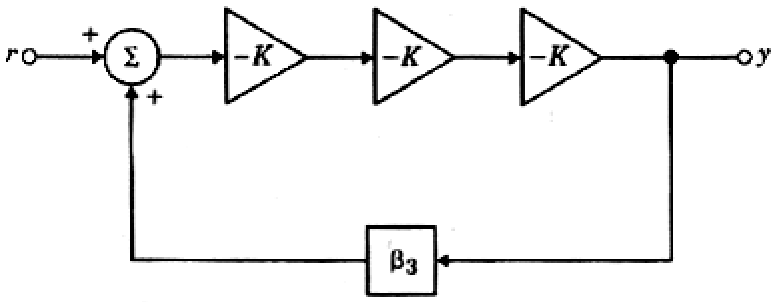
FIGURE 3.23



(a)



(b)



(c)

موفق باشید