24-352 Dynamic Systems and Control: QUIZ 7

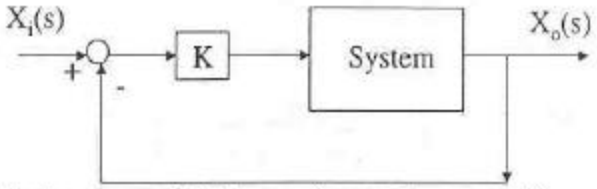
Close book and notes. You have 45 minutes to complete the following questions.

NAME: _____ 30 April 2001

A 1st order system has the transfer function, $H(s) = 100/(s + 2)$.

1. What is the time constant τ for this system?

Suppose we controlled this system using the strategy shown below.



2. What is the name of this type of control approach?
3. What is the closed loop transfer function for this system?
4. Suppose we have a unit step function input, i.e. $x_i(t) = H(t)$. What value of K will result in a steady state error of 5%, i.e. $x_i(\infty) - x_o(\infty) = 0.05$?
5. For the step function input what are the location(s) of the pole(s) of $X_o(s)$ and is the system stable?
6. What is the time constant for the closed loop system?
7. How would you change the block diagram given above if you wanted to use integral control?
8. What would be the advantage of integral control in this application?

ANSWERS

f(t)	F(s)
H(t)	1/s
e^{-at}	1/(s + a)

Quiz # 7 Total Points = 14

(1) 1. $\tau = 1/2$ ✓

(1) 2. Proportional ✓

(1) 3. $T(s) = \dfrac{\frac{100K}{s+2}}{1+\frac{100K}{s+2}} = \dfrac{100K}{s+2+100K}$ ✓

4. $X_o(\infty) = \lim_{s \to 0} s\,\underline{X}_o(s)$ ✓

(5) where $\underline{X}_o(s) = \dfrac{1}{s} \cdot \dfrac{100K}{s+2+100K}$ ✓

$\hookrightarrow X_o(\infty) = \dfrac{100K}{2+100K} = X_i(\infty) - .05 = .95$ ✓

$\Rightarrow 100K = 1.9 + 95K \Rightarrow 5K = 1.9$

$K = 0.38 \approx 0.4$ ✓

(3) 5. Poles at $s = 0$ ✓ $s = -(2+100K)$ ✓
Yes, system is stable ✓

(1) 6 Time constant $= \dfrac{1}{2+100K}$ ✓

(1) 7. Replace K with $\dfrac{K}{s}$ ✓

(1) 8. Zero steady state error. ✓