University of Massachusetts Lowell
EECE4130 Problem Set #4

1. For the negative-feedback system the open-loop transfer function $G(s)$ and feedback gain $H(s)$ are

$$G(s) = \frac{4s + K}{s^2} \qquad H(s) = \frac{1}{s+2}$$

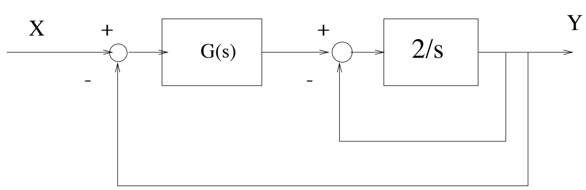
a. What is the transfer function of the closed-loop system.

b. Find the characteristic equation of the closed-loop system.

c. Determine the condition on the the gain K for stability.

d. Can the system become marginally stable? If so for what value of K and what is the frequency of oscillation.

2. For the system below



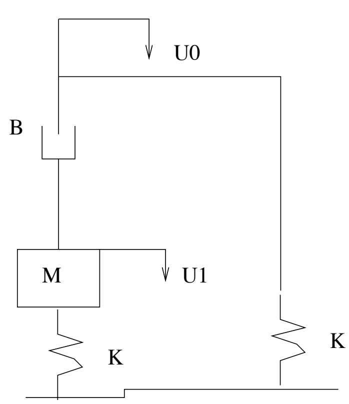
a. Determine the transfer function Y/X

b. If the error is defined as $e = x(t) - y(t)$ determine a $G(s)$ such that $e(\infty) = 1/2$ when $x(t) = tu(t)$.

3. Consider the system shown in Figure. Using the mobility analogy.

a. Determine the transfer function between the velocities $U_1(s)/U_o(s)$.

b. If $u_o(t) = \delta(t)$ what is $u_1(t)$ when $M = 1$, $K = 1$ and $B = 1/2$.



4. Given the unity negative feedback system where

$$G(s) = \frac{Ks(s+2)}{(s^2 - 4s + 8)(s+3)}$$

(a) Find the value of K for stability
(b) Find the frequency of oscillation when the system is marginally stable.

5. Given the unity negative feedback system where

$$G(s) = \frac{K(s+2)}{s(s+1)(s+3)} \quad H(s) = \frac{s+6}{s+7}$$

for what values of K will the system be stable.