Concordia University

Department of Computer Science and Software Engineering

SOEN 385

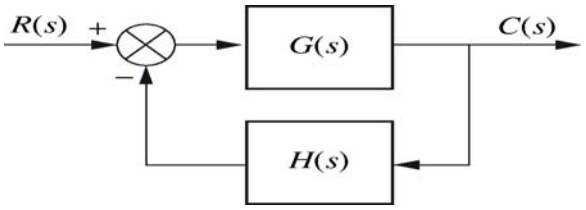
Control Systems and Applications

Midterm Test

March 10, 2011

You are allowed to use one 8"x11" page crib sheet, one sided.
Answer all questions.
Only non-programmable calculators approved by the ENCS Faculty are allowed.

Problem 1. The three parts a, b, and c are independent. You can answer them in any order. Mistake in one part doesn't affect the other parts.



Given a closed-loop (feedback) control system as shown by the figure above, and for a unit step input:

Where $G(s) = \dfrac{K}{s(s+2)}$ and H(s) = 1

a) [10%] What is the value of K for which the closed-loop control system is under-damped?

b) [10%] What is the settling time Ts ?

c) [10%] Assuming K= 4, find T_P and the Percentage Overshoot (% OS) for this case .

Problem 2. The three parts a, b, and c are independent. You can answer them in any order. Mistake in one part doesn't affect the other parts.

Given the open-loop transfer function

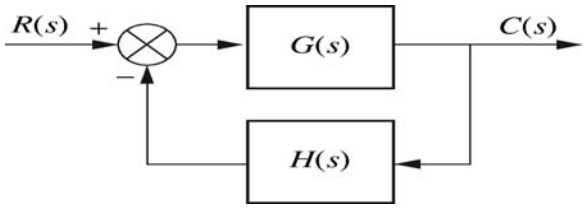
$$G(s) = \frac{Y(s)}{U(s)} = \frac{as + b}{s^2 + d}$$

a) [15%] Draw a signal flow graph representing this transfer function.

b) [15%] Write down the state variable equations (state space) representing the above system (i.e. the set of first-order differential equations). You must write the state variable equations *in vector/matrix form*.

c) [10%] What is the condition on the coefficient(s) so that the system is stable (i.e. the poles are on the left side of the complex s-plane?

Problem 3. [15%] Using the same transfer function G(s) as in problem 1, and connect a unity feedback on the system as shown in the figure below. What are the conditions for the system to be stable (poles on the left half of the complex plane)? Note that these conditions involve the given coefficients.



Where H(s) = 1

Problem 4. [15%] Consider the mechanical system in the figure below. Write the differential equations describing the motion of the system.