Department of Electrical and Computer Engineering
The University of Alabama in Huntsville

CPE 381: Fundamentals of Signals and Systems for Computer Engineers

Homework #3

Due: Wednesday, February 25 at 2:15 pm
Please bring hardcopy to the class and upload softcopy to Angel

Student name:

.....

1 20	2 10	3 10	4 25	5 10	6 15	7 5	8 5	Total

---

1. (20 points) A system with input x(t) and output y(t) is defined by the following differential equation:

$$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = x(t)$$

Find the impulse response *h(t)* and the unit-step response *s(t)*.

2. (10 points) The Laplace transform of the system transfer function is:

$$H(s) = \frac{s}{s^2 + s + 1}$$

find the unit step response *s(t)*, and then use it to find the response due to the input

$u(t) - u(t-1)$

3. (10 points) Pr. 3.30

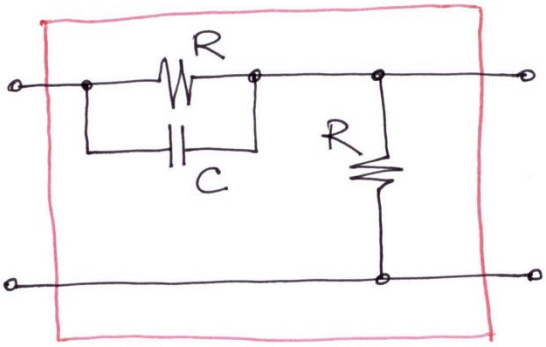
3.30. Feedback stabilization

An unstable system can be stabilized by using negative feedback with a gain K in the feedback loop. For instance, consider an unstable system with transfer function

$$H(s) = \frac{2}{s-1}$$

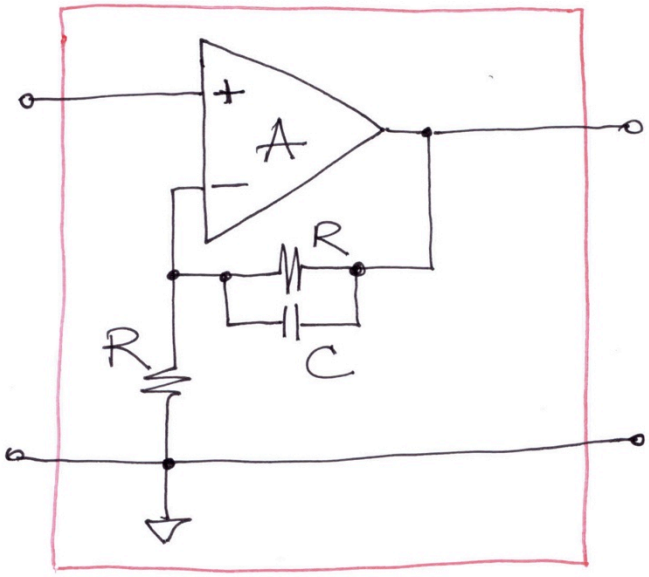
which has a pole in the right-hand s-plane, making the impulse response of the system $h(t)$ grow as t increases. Use negative feedback with a gain $K > 0$ in the feedback loop, and put $H(s)$ in the forward loop. Draw a block diagram of the system. Obtain the transfer function $G(s)$ of the feedback system and determine the value of K that makes the overall system BIBO stable (i.e., its poles in the open left-hand s-plane).

4. a) (10 points) What is the transfer function of the following circuit:



b) (5 points) What is the transfer function of the following circuit?
Hints:

- you can use solutions of problem #2 and #3a
- to simplify the result you can assume that A → ∞



c) (10 points) Find and plot the unit-step response *s*(t) of the system?

5. (10 points) Find the inverse Laplace transform of the following function:

$$X(s) = \frac{1}{(s+4)(s-4)}$$

What is the ROC of this function?

6. (15 points) Consider a second order ($N = 2$) differential equation

$$y''(t) + 5y'(t) + 4y(t) = x(t)$$

Assume the above equation represents a system with input x(t) and output y(t). Find the impulse response h(t) and the unit-step response s(t) of the system.

7. (5 points) Evaluate formula for power distribution over frequency of a periodic signal *x(t)* (Parseval's theorem). Describe Magnitude Line Spectrum and Phase Line Spectrum and their symmetry.

8. (5 points) Represent the trigonometric Fourier series of a real-valued periodic signal *x(t)*. How do you calculate coefficients?