Homework 10
Due: Thursday, November 15, 2007, at 5pm
Homework 10 GSI: Mark Johnson

Reading OWN Sections 9.3, 9.5 - 9.6, 9.7.1 - 9.7.3.

Practice Problems *(Suggestions.)* OWN 9.7, 9.14, 9.16

(*Submit your grades to ee120.gsi@gmail.com*)

Problem 1 *(Laplace Transform Properties.)*

(a) OWN 9.21 (g)

(b) OWN 9.26

Problem 2 *(Inverse Laplace Transform.)*

(a) OWN 9.22 (c)

(b) OWN 9.22 (e)

(c) OWN 9.22 (g)

Problem 3 *(Stability and Causality.)*

(a) OWN 9.51 (a)

(b) OWN 9.51 (b)

(c) OWN 9.51 (c)

Problem 4 *(Stability and Causality (continued).)*

(d) OWN 9.51 (d)

(e) OWN 9.51 (e)

(f) OWN 9.51 (f)

(g) OWN 9.51 (g)

Problem 5 *(An LTI System.)*

For a linear time-invariant system, it is known that the system function (also called *transfer function*) is given by

$$H(s) \quad = \quad \frac{5(s-3)}{(s+2)(s^2-2s+5)}. \tag{1}$$

(a) Draw the pole/zero diagram for $H(s)$.

(b) Determine the differential equation that describes this system.

(c) Suppose that apart from $H(s)$, you are also told that the system is *causal*. Find the corresponding impulse response $h(t)$ of the system. Is the resulting system also stable?

(d) Suppose that apart from $H(s)$, you are also told that the system is *stable*. Find the corresponding impulse response $h(t)$ of the system. Is the resulting system also causal?

Problem 6 *(LTI System Analysis.)*

OWN 9.32.

Problem 7 *(LTI System Analysis.)*

Consider the cascade of two LTI systems as shown below

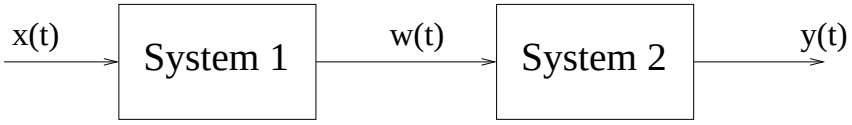

Figure 1: Problem 8

where we are told that

1. System 1 is causal with impulse response $h(t) = e^{-2t}u(t)$
2. System 2 is causal and is characterized by the following differential equation relating its input $w(t)$ and output $y(t)$

$$\frac{dy(t)}{dt} + y(t) = \frac{dw(t)}{dt} + \alpha w(t)$$

3. If the input is $x(t) = e^{3t}$, then the output is $y(t) = 0$.

(a) find the system function $H(s) = Y(s)/X(s)$, determine its ROC, and sketch the pole-zero pattern. (Your answers should **only** have numbers in them. You have enough information to determine the value of α.)

(b) Determine the differential equation relating $y(t)$ and $x(t)$.