Homework 10
Due: Thursday, November 16, 2006, at 5pm
GSI: Omar Bakr

Reading OWN Chapter 9: 9.1-9.3, 9.5, 9.7.1, 9.7.2.

Practice Problems *(Suggestions.)* OWN 9.1, 9.2, 9.3, 9.4, 9.5

Problem 1 *(Inverse Laplace.)*

OWN 9.22 (c), (e), (g)

Problem 2 *(Region of convergence.)*

OWN 9.23 (all parts).

Problem 3 *(An LTI system.)*

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

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

(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 4 *(System analysis.)*

OWN 9.32.

Problem 5 *(A simple fact about Laplace transforms.)*

OWN 9.41 (a), (c)

Problem 6 *(Deconvolution)*

OWN 9.47 (all parts)

Problem 7 *(Stability and Causality.)*

OWN 9.51 (a), (b), (c)

Problem 8 *(Stability and Causality.)*

OWN 9.51 (d), (e), (f), (g)

Problem 9 *(LT Properties)*

Suppose we are given the following information about a causal and stable LTI system with impulse response $h(t)$ and a rational system function $H(s)$:

- The steady state response to a unit step is $\frac{1}{3}$.
- When the input is $e^t u(t)$, the output is absolutely integrable.
- The signal

$$\frac{d^2h(t)}{dt^2} + 5\frac{dh(t)}{dt} + 6h(t)$$

  is of finite duration.
- The number of zeros of $h(t)$ is one less than the number of poles.

Determine $H(s)$ and the associated ROC.