GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering

EE2201A
Homework Assignment No. 7

Date Assigned: May 21, 1999
Date Due: May 28, 1999

Reading Assignment: Read pp. 654-703 of Oppenheim and Willsky.

Homework Assignment: Hand in Problems 7.1*, 7.2*, and 7.3*.

REMEMBER: The final exam will be given on Wednesday, June 9, 1999 at 8:00 am. It will cover the entire course.

Problem 7.1*:

Determine the Laplace transform of each of the following signals. Be sure to state the region of convergence.

(a) $x_a(t) = 2e^{-2t}u(t) + 2e^{-3t}u(t).$

(b) $x_b(t) = e^{-|t|} = e^{-t}u(t) + e^{t}u(-t).$

(c) $x_c(t) = e^{-t}\sin(2t)u(t).$

(d) $x_d(t) = \dfrac{d\delta(t-1)}{dt} + 2\delta(t-1).$

(e) $x_d(t) = u(t) - u(t-10)$

Problem 7.2*:

Determine the inverse Laplace transform of each of the following. Do parts (a) and (c) by the partial fraction expansion method. Then you should be able to do most of the rest of the work by applying the properties of the Laplace transform in the table on p. 691.

(a) $X_a(s) = \dfrac{1}{s^2+9} \qquad \mathcal{R}e\{s\} > 0$

(b) $X_d(s) = \dfrac{se^{-s2}}{s^2+9} \qquad \mathcal{R}e\{s\} > 0$

(c) $X_a(s) = \dfrac{s^2+1}{s(s+4)} \qquad \mathcal{R}e\{s\} > 0$

(d) $X_b(s) = \dfrac{s^2+1}{s(s+4)} \qquad \mathcal{R}e\{s\} < -4$

(e) $X_b(s) = \dfrac{s^2+1}{s(s+4)} \qquad -4 < \mathcal{R}e\{s\} < 0$

(f) $X_d(s) = \dfrac{(s^2+1)e^{s2}}{s(s+4)} \qquad \mathcal{R}e\{s\} > 0$

Problem 7.3*:

A causal linear time-invariant system has system function

$$H(s) = \frac{2s^2+8}{s^2+3s+2}.$$

(a) Determine the differential equation that is satisfied by the input $x(t)$ and the output $y(t)$.

(b) Plot the poles and zeros in the s-plane and shade the region of convergence of $H(s)$.

(c) Is the system stable? How do you know?

(d) Determine the impulse response of the system.

(e) Determine an equation for the frequency response of the system.

(f) Determine equations for the magnitude squared $|H(j\omega)|^2$ and the phase $\angle H(j\omega)$.

(g) If the input is $x(t) = 10 + 10\cos(2t)$ for $-\infty < t < \infty$, use the frequency response to determine the output $y(t)$ for $-\infty < t < \infty$.

(h) Determine the output when the input is $x(t) = [10 + 10\cos(2t)]u(t)$. Does the output in this case tend to approach the output in part (g)? What condition on the system must be true for this to occur?