

Homework #1

1) Problem from Phillips and Parr: 7.16, 7.26

- 2 Find the inverse Laplace transforms of the following functions of s . Tell what Laplace transform theorems you use in each case.

a. $X_1(s) = \frac{s+5}{s^2+10s+34}$

b. $X_2(s) = \frac{1-e^{-2s}}{s+4}$

c. $X_3(s) = \frac{1}{(s+1)^2}$

- 3 Determine the Laplace transform and the associated region of convergence and pole-zero plot for each of the following functions of time:

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

b. $x(t) = e^{-4t}u(t) + e^{-5t}(\sin 5t)u(t)$

c. $x(t) = e^{2t}u(t) + e^{3t}u(-t)$

d. $x(t) = te^{-2|t|}$

e. $x(t) = |t|e^{-2|t|}$

f. $x(t) = |t|e^{2t}u(-t)$

g.

$$x(t) = \begin{cases} 1, & 0 \leq t \leq 1 \\ 0, & \text{elsewhere} \end{cases}$$

h.

$$x(t) = \begin{cases} t, & 0 \leq t \leq 1 \\ 2-t, & 1 \leq t \leq 2 \end{cases}$$

i. $x(t) = \delta(t) + u(t)$

j. $x(t) = \delta(3t) + u(3t)$

4 Consider a signal $x(t)$ whose Laplace transform $X(s)$ has a zero at $s = 0$ and poles at $s = -3$ and $s = 3$.

- a. Write the general form of the $X(s)$.
- b. Sketch the pole-zero plot.
- c. Find and sketch $x(t)$ if it is known to be causal.
- d. Find and sketch $x(t)$ if it is known to be anticausal.
- e. Find and sketch $x(t)$ if it is known that its Fourier transform exists.

5)

To specify the Laplace transform of a signal $x(t)$ requires two things: an algebraic function $X(s)$ and a region of convergence. How many distinct signals are there with the following algebraic expression of $X(s)$? Explain.

$$X(s) = \frac{(s-1)(s-2)}{(s+1)(s+2)(s^2+5s+6)}$$