Problem 7.3-7 in Lathi

Problem 7.4-3 in Lathi

**ECE-220 Problem 19**  Consider an LTI system whose response to the input

\[ x(t) = \left[ e^{-t} + e^{-3t} \right] u(t) \]

is

\[ y(t) = \left[ 2e^{-t} - 2e^{-4t} \right] u(t). \]

(a) Find the frequency response of this system.

(b) Determine the system’s impulse response.

(c) Find the differential equation relating the input and the output of this system.

**ECE-220 Problem 20**  Consider two LTI systems with impulse responses \( h_1(t) \) and \( h_2(t) \):

\[ h_1(t) = \delta(t - 5) \quad h_2(t) = -\delta(t) + 2e^{-t}u(t). \]

(a) Determine the frequency response of each of the systems. Sketch the magnitude \( |H(j\omega)| \) and phase \( \angle H(j\omega) \) responses for each system. Are the magnitude responses identical? What about the phase responses? Could you have sketched the frequency response of system 2 by first sketching the pole-zero plot?

(b) Determine the output of each system when the input is \( x(t) = \cos\left(\frac{\sqrt{3}t}{2}\right) + \cos(\sqrt{3}t) \) for all time. Use Matlab to “sketch” the outputs over the interval 0 to 100 with 0.01 between samples. How do the outputs compare to the input?
ECE-220 Problem 21 (Old exam questions)
Consider the continuous-time LTI system that has the impulse response $h(t)$ shown in Figure 21.1 and the frequency response $H(j\omega)$ shown in Figure 21.2.

![Figure 21.1: Impulse response $h(t)$ of the CT LTI system in Problem 3](image1)

![Figure 21.2: Frequency response (magnitude and phase plots) of the CT LTI system in Problem 3](image2)

In parts a-d below, you are given 4 signals that are inputs to the LTI system defined above: Determine and sketch the output of the system corresponding to each input. Make sure to label your sketches!

(a) Input to system: $x_a(t) = \delta(t)$. Determine the output $y_a(t)$. Provide a sketch of $y_a(t)$ and justification of your answer.

(b) Input to system: $x_b(t) = \cos(2\pi t)$. Determine the output $y_b(t)$. Provide a sketch of $y_b(t)$ and justification of your answer.

(c) Input to system: $x_c(t) = p(t) \cos(100\pi t)$, where $p(t)$ and its Fourier transform $P(j\omega)$ are shown in Figure 21.3. Determine the output $y_c(t)$. Provide a sketch of $y_c(t)$ and justification of your answer.

(d) Input to system: $x_d(t)$ shown in Figure 21.4. Determine the output $y_d(t)$. Provide a sketch of $y_d(t)$ and justification of your answer.
Figure 21.3: Signal $p(t)$ and its Fourier transform $P(j\omega)$.

Figure 21.4: Input signal $x_d(t)$ for Problem 3d