Problem 1: What is the output of this filter when \( x(t) = \sin(50t) \)?

Problem 2: Frequency response of a real CT filter.
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.

\[
h(t) = \frac{1}{2} \times \frac{\sin(10\pi(t-3))}{\pi(t-3)}
\]

Figure 21.1: Impulse response \( h(t) \) of the CT LTI system in Problem 3

\[
|H(j\omega)|
\]

\[\angle H(j\omega) = -3\omega\]

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

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