1. [100 pts] Find the Fourier transforms of the following signals:
   (a) \( f(t) = [e^{-t} - e^{-3t}]u(t) \)

   (b) \( f(t) = \delta(t) - e^{-2t}u(t) \)

   (c) \( f(t) = 2\delta(2t) - \delta'(4t) \) where \( \delta'(t) = \frac{d\delta(t)}{dt} \)
2. [100 pts] Find the inverse Fourier transforms of the following functions:
(a) $F(\omega) = \delta(\omega) + \text{sinc}(\omega)$

(b) $F(\omega) = \frac{e^{j\omega}}{1 - j\omega}$  
Hint: If $y(t) = x(-t)$, how is $Y(\omega)$ related to $X(\omega)$?

(c) $F(\omega) = \frac{j\omega}{1 + j\omega}$
3. [100 pts] Consider the circuit shown in Fig PR-3.
   (a) Find the frequency response, \( H(\omega) = \frac{V_o(\omega)}{V_i(\omega)} \), of the circuit.

(b) Find the impulse response, \( h(t) \), of the circuit.

(c) Is the circuit causal? Stable? Justify your answers.

(d) Find the output in response to the input, \( v_i(t) = 100u(t) \).

![Figure PR-3](image-url)
4. [100 pts] The Fourier transform of an input signal, $X(\omega)$, and the frequency response of a particular system, $H(\omega)$, are shown in Figure PR-4.

(a) Sketch the Fourier transform of the output. Label all magnitudes and corner frequencies.

(b) Determine the amount of energy in the input signal.

(c) Is the system causal? Justify your answer.

(d) If the input signal were converted to a digital signal what minimum sampling frequency (in Hertz) should be used to avoid aliasing?

Figure PR-4