1. Find the Fourier transforms of the following functions:
   
   (a) \( f(t) = e^{-|t|} \cos(t) \).
   
   (b) \( f(t) = \begin{cases} 
   t + 1 & \text{for } t \in [-1, 0] \\
   -t + 1 & \text{for } t \in [0, 1] \\
   0 & \text{otherwise}
   \end{cases} \)

2. We are given the magnitude and phase plot below, corresponding to frequency response \( H(i\omega) \) of an LTI filter. Find the system impulse response. Is it causal?

3. Use properties of the Fourier transform to compute the integrals
   
   a) \( \int_{-\infty}^{\infty} \frac{\sin(t)}{t} \, dt \);

   b) \( \int_{-\infty}^{\infty} \left[ \frac{\sin(t)}{t} \right]^2 \, dt \)
4. In the system below

\[
\begin{align*}
  x(t) &\quad u(t) &\quad H_{high} &\quad v(t) &\quad y(t) &\quad H_{low} &\quad z(t) \\
  \times &\quad \cos(\omega_0 t) &\quad &\quad \times &\quad \cos(\omega_0 t) &\quad &\quad \\
\end{align*}
\]

- \( H_{high} \) is an ideal high-pass filter with cutoff frequency \( \omega_0 \).
- \( H_{low} \) is an ideal low-pass filter, also with cutoff frequency \( \omega_0 \).
- \( u(t) = x(t) \cos(\omega_0 t) \) and \( y(t) = v(t) \cos(\omega_0 t) \).
- \( x(t) \) is band-limited to \([-B, B]\), as depicted in the figure in the next page. \( X(0) = A \).
- \( \omega_0 > 2B \).

Sketch the Fourier transforms \( U(i\omega) \), \( V(i\omega) \), \( Y(i\omega) \) and \( Z(i\omega) \), and relate \( z(t) \) to \( x(t) \). Justify your answer.