Ideal fractional delay

The ideal fractional delay discrete-time LTI system has the frequency response

$$H^f(\omega) = \mathrm{e}^{-\mathrm{j}\tau\omega}, \quad \text{for} \quad |\omega| < \pi. \tag{1}$$

This system delays the input signal by τ samples. The value of τ does not have to be an integer.

1. Sketch the frequency response magnitude and phase for $|\omega| < 2\pi$.

2. Use the inverse DTFT to find the impulse response $h(n)$ of the ideal fractional delay system with parameter τ.

3. Can the ideal fractional delay system be implemented using a difference equation? Explain.