

Concept Question 6-5: How can we tell right away that the impulse response of a brick-wall lowpass filter must be noncausal?

A true brick-wall lowpass filter has zero phase, so its frequency response function is even. Its impulse response is the inverse Fourier transform of its frequency response, and the inverse Fourier transform of a real and even function is a real and even function (see the list of properties below Eq. (5.130)). So the impulse response, which must be real, is also even, hence it is noncausal.