

4.3 For the sake of simplicity let the filter order be odd and  $N = 4$ .

$$H(z) = h(0) + h(1) z^{-1} - h(1) z^{-2} - h(0) z^{-3}$$

Now, for  $z = 1$  we have  $H(1) = h(0) + h(1) - h(1) - h(0) = 0$

Hence, it is not possible to have a lowpass filter, with  $N =$  even, with antisymmetric impulse response since the filter has a zero at  $z = 1$ , i.e., inside the passband. For an even order filter, for example,  $N = 5$ , we have

$$H(z) = h(0) + h(1) z^{-1} + h(2) z^{-2} - h(1) z^{-3} - h(0) z^{-4}$$

Now,  $h(2)$  must be zero if the filter shall have an antisymmetric impulse response. Hence, also in this case we have a zero at  $z = 1$ . To summarize, a lowpass filter cannot have an antisymmetric impulse response.