

Homework for Module 2

1. Starting from the definition of the Chebyshev function

$$C_N(x) = \begin{cases} \cos(N \cos^{-1} x), & \text{if } |x| \leq 1 \\ \cosh(N \cosh^{-1} x), & \text{if } |x| > 1 \end{cases}$$

show that $C_N(x)$ obeys the following recursion: $C_{N+1}(x) = 2xC_N(x) - C_{N-1}(x)$. Consider the cases $|x| \leq 1$ and $|x| > 1$ separately.

2. Design a bandpass discrete-time Elliptic filter with the following specifications:

$\omega_{s1}=0.2\pi$, $\omega_{p1}=0.3\pi$, $\omega_{p2}=0.7\pi$, $\omega_{s2}=0.8\pi$ and $G_p=0.99$ and $G_s=0.01$.

Plot the magnitude response and group delay for the resulting filter design. Realize the transfer function as a cascade of first-order and second-order sections with real-valued coefficients. List the coefficients for each section.