1. We wish to use the Kaiser window method to design a real-valued causal FIR filter with generalized linear phase that meets the following specifications:

\[
\begin{align*}
0.9 < |H(\omega)| &< 1.1, \quad 0 \leq |\omega| \leq 0.2\pi \\
|H(\omega)| &< 0.06, \quad 0.3\pi \leq |\omega| \leq 0.475\pi \\
1.9 < |H(\omega)| &< 2.1, \quad 0.525\pi \leq |\omega| \leq \pi
\end{align*}
\]

This specification is to be met by applying the Kaiser window to the ideal real-valued impulse response associated with the ideal frequency response \(H_d(\omega)\) with its magnitude given by:

\[
|H_d(\omega)| = \begin{cases} 
1, & 0 \leq |\omega| \leq 0.25\pi \\
0, & 0.25\pi \leq |\omega| \leq 0.5\pi \\
2, & 0.5\pi \leq |\omega| \leq \pi
\end{cases}
\]

(a) What is the maximum value of \(\delta\) that can be used to meet this specification? What is the corresponding value of \(\beta\)?
(b) What is the maximum value of \(\Delta \omega\) that can be used to meet the specification? What is the corresponding value of \(M\)?
(c) Determine the ideal impulse response \(h_d[n]\).
2. Optimum approximations of FIR filters