FIR(1).

1. 用黑人窗, $N=37$

2. 用 hanning. $N=63$

3. $N=3$. $M=1$, Low pass. $f_c=2500Hz$, $f_s=8000Hz$. Hamming.

(a). $w(n)=0.54+0.46\cos\pi n \Rightarrow w(n)=\{0.08, \underset{\uparrow}{1}, 0.08\}$.

~~$h(n)=w(n)\cdot \mathrm{sinc}(n)=$~~ $\omega_c=2\pi f_c/f_s=0.625\pi$

$\mathrm{sinc}(n)=\begin{cases}0.625 & n=0\\ \frac{\sin\omega_c n}{n\pi} & n\neq 0\end{cases} \Rightarrow h(n)=w(n)\cdot\mathrm{sinc}(n)=\{0.024, \underset{\uparrow}{0.625}, 0.024\}$. 平移

$\Rightarrow H(z)=\sum_{n=0}^{2} h(n)z^{-n}=0.024+0.625z^{-1}+0.024z^{-2}$

$\Rightarrow y(n)=0.024x(n)+0.625x(n-1)+0.024x(n-2)$.

(b) $H(\omega)=e^{-j\omega}(0.625+0.048\cos\omega) \Rightarrow |H(\omega)|=0.625+0.048\cos\omega$

$\Rightarrow |H(0)|=0.673$. $|H(0.5\pi)|=0.625$. $|H(\pi)|=0.577$

(c) $H(\omega)=|H(\omega)|e^{j\angle H} \Rightarrow \angle H=-\omega \Rightarrow \tau(\omega)=1$ ∴ 是.

4. $N=5$, 带阻, $f_L=2kHz$, $f_H=2.4kHz$. $f_s=8kHz$. 求 $H(z)$.

$\omega_L=0.5\pi$, $\omega_H=0.6\pi$. $h(0)=1-\frac{\omega_H-\omega_L}{\pi}=0.9$. $h(1)=h(-1)=-\frac{\sin\omega_H-\sin\omega_L}{\pi}$

$h(2)=h(-2)=0.094$. $=0.0156$

$\Rightarrow H(z)=\sum_{n=0}^{4} h(n)z^{-n}=0.094+0.0156z^{-1}+0.9z^{-2}+0.0156z^{-3}+0.094z^{-4}$

5. low pass. $0\sim0.15\pi$. 用 Hamming. $\Delta\omega=0.25\pi \geq \frac{3.3\times2}{N} \Rightarrow N=27$, $M=13$

∴ $w(n)=0.54+0.46\cos\frac{\pi n}{13}$, $\omega_c=\frac{1}{2}(0.15\pi+0.4\pi)=0.275\pi$

$\mathrm{sinc}(n)=\begin{cases}0.275 & n=0\\ \frac{\sin\omega_c n}{\pi n} & n\neq0\end{cases}$ $n\in[-13,13]\wedge n\in\mathbb{Z}$

$h_1(n)=w(n)\cdot\mathrm{sinc}(n)=\begin{cases}0.275 & n=0\\ \left[0.54+0.46\cos\frac{\pi n}{13}\right]\left[\frac{\sin(0.275\pi\cdot n)}{\pi n}\right] & n\neq0\end{cases}$

$h(n)=h_1(n-13)$ 平移.

6. $N=5$. $M=2$. Blackman.

$$W(n) = 0.42 + 0.5\cos\frac{\pi n}{2} + 0.08\cos\pi n$$

$$\Rightarrow W(-1) = W(1) = 0.34. \quad W(2) = W(-2) = 0. \quad W(0) = 1$$

$$w_c = \frac{1}{2}\times 2\pi\,(f_L + f_H)/f_s = \frac{\pi}{2}$$

$$\mathrm{sinc}(n) = \begin{cases} \frac{1}{2} & n=0 \\ \frac{\sin\frac{\pi}{2}n}{\pi n} & n\neq 0 \end{cases} \qquad \mathrm{sinc}(-2) = \mathrm{sinc}(2) = 0. \quad \mathrm{sinc}(1) = \mathrm{sinc}(-1) = \frac{1}{\pi}$$

$$\therefore h_1(n) = \{0,\ \frac{0.34}{\pi},\ \underset{\uparrow}{\frac{1}{2}},\ \frac{0.34}{\pi},\ 0\}$$

$$H(z) = \sum_{n=0}^{4} h(n) z^{-n} = \frac{0.34}{\pi} z^{-1} + \frac{1}{2} z^{-2} + \frac{0.34}{\pi} z^{-3}$$

$$H(w) = e^{-2jw}\left(\frac{1}{2} + \frac{0.68}{\pi}\cos w\right) \Rightarrow |H(w)| = \frac{1}{2} + \frac{0.68}{\pi}\cos w. \quad \angle H = -2w$$