6 3 (a) $|H(j\omega)| = \frac{|1-j\omega|}{|1+j\omega|} = \frac{\sqrt{1+\omega^2}}{\sqrt{1+\omega^2}} = 1$

A值为1

(b) ∵ $H(j\omega) = |H(j\omega)| e^{\measuredangle H(j\omega)}$

∴ $\measuredangle H(j\omega) = \arctan(\frac{-\omega}{1}) - \arctan(\frac{\omega}{1})$

$= -2\arctan\omega$

∴ 群时延 $\tau(\omega) = -\frac{d}{d\omega}(-2\arctan\omega)$

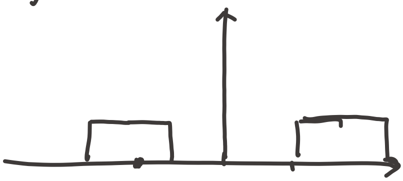
$= 2\frac{1}{\omega^2+1}$

则 $\tau(\omega)$ 在 $\omega>0$ 总大于0

$\omega<0$.

2.3 是对的

6 6 (a) $H(e^{j\omega})$

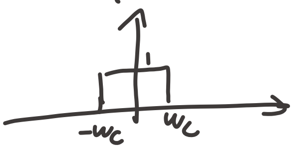


记 $p[n] = \frac{\sin w_c n}{\pi n} \xrightarrow{\mathcal{F}} \begin{cases} 1 & |\omega|<w_c \\ 0 & else \end{cases}$

则 $H(e^{j\omega}) = \frac{1}{2\pi}\begin{cases} 1 & |\omega|<w_c \\ 0 & else \end{cases} * \mathcal{F}\{g[n]\}$.

∵ $H(e^{j\omega}) = P(e^{j(\omega-\pi)})$

$\mathcal{F}\{g[n]\}$ 的功能相当于相移π



∴ $\mathcal{F}\{g[n]\} = 2\pi\,\delta(\omega-\pi)$.

∴ $g[n] = e^{j\pi n} = (-1)^n$

6.22 (a) $|H(j2\pi)| = \frac{2}{3} = |H(j-2\pi)|$

由$H(j\omega)$的响应图，

$\measuredangle H(j2\pi) = \frac{\pi}{2}$. $\quad \measuredangle H(j-2\pi) = -\frac{\pi}{2}$

$x(t) = \cos 2\pi t * \delta(t + \frac{\theta}{2\pi})$

$= \frac{e^{j2\pi t} + e^{-j2\pi t}}{2} * \delta(t + \frac{\theta}{2\pi})$

$\therefore y(t) = \left(\frac{1}{2} e^{j2\pi t} \cdot \frac{2}{3} e^{j\frac{\pi}{2}} + \frac{1}{2} e^{-j2\pi t} \frac{2}{3} \cdot e^{-j\frac{\pi}{2}}\right) * \delta(t + \frac{\theta}{2\pi})$

$= \frac{1}{3}\left(e^{j(2\pi t + \frac{\pi}{2})} + e^{-j(2\pi t + \frac{\pi}{2})}\right) * \delta(t + \frac{\theta}{2\pi})$

$= \frac{2}{3} \cos(2\pi t + \frac{\pi}{2} + \theta)$

(b) $\because |H(j4\pi)| = |H(j-4\pi)| = 0$

$\therefore y(t) = 0$. 被$H(j\omega)$滤除

6-28 (iv) $|H(j\omega)| = \frac{\sqrt{1 + \frac{\omega^2}{100}}}{\sqrt{1+\omega^2}}$

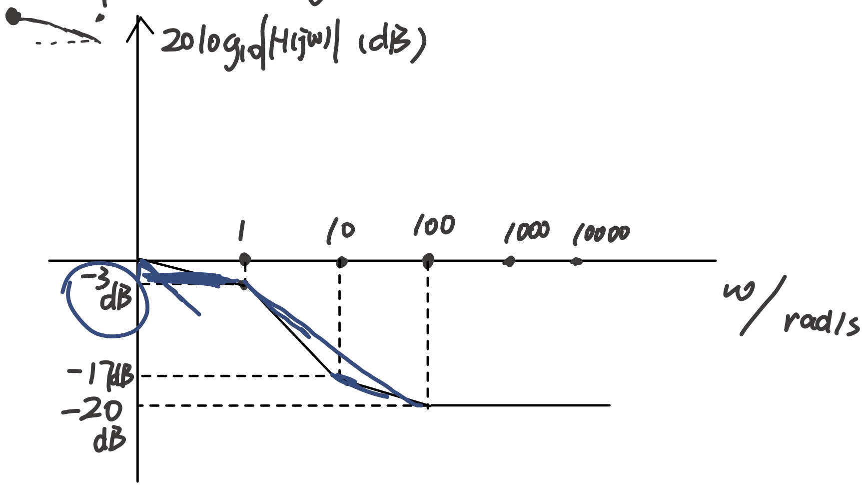
$20\log_{10}|H(j\omega)| = 10\log_{10}\left(\frac{1 + \frac{\omega^2}{100}}{1+\omega^2}\right)$

$10\left[\log_{10}(1 + \frac{\omega^2}{100}) - \log_{10}(1+\omega^2)\right]$.

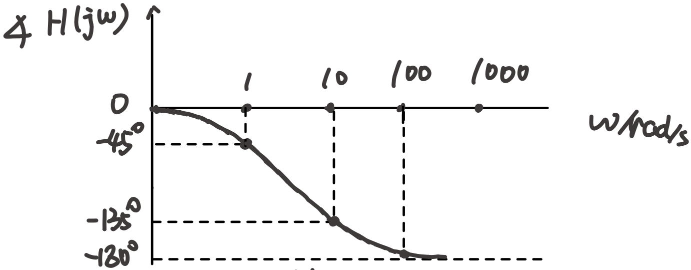
$\omega \ll 0.1$ 时 $\log_{10}(1+\frac{\omega^2}{100}) = 0$ $\quad 20\log_{10}|H(j\omega)| = 0$

$\log_{10}(1+\omega^2) = 0$

$\omega \ll 10$ 时 $20\log_{10}|H(j\omega)| = -10\log_{10}(1+\omega^2)$



$\measuredangle H(j\omega) = -\arctan\frac{\omega}{10} - \arctan\omega$



$0 < \omega < 1$ $\quad \arctan\frac{\omega}{10} \approx 0°$

$\arctan\omega$ 在 $\omega=1$ 时为 $45°$.

$\omega = 10$ $\quad \arctan\frac{\omega}{10} = 45°$

$\arctan\omega \approx 90°$

$\omega = 100$ $\quad \arctan\frac{\omega}{10} \approx 90°$ arctan

$\omega > 100$ 以 $-180°$ 为渐近

(vi) $|H(j\omega)| = \dfrac{\sqrt{1^2+\frac{\omega^2}{100}}}{\sqrt{1+\omega^2}}$

$20\log_{10}|H(j\omega)| = 10\left[\lg\left(1+\frac{\omega^2}{100}\right) - \lg(1+\omega^2)\right]$ ①

$\omega \leq 0.1$ ① ≈ 0

$\omega = 1$ ① $= -3\text{dB}$.

$\omega = 10$. ① $= 3 - 20 = -17\text{dB}$

$\omega \geq 100$ ① $\approx -20\text{dB}$ (渐近)

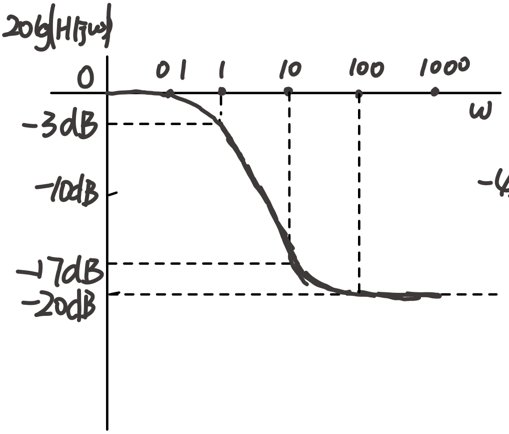
$\angle H(j\omega) = \arctan\frac{\omega}{10} - \arctan\omega$

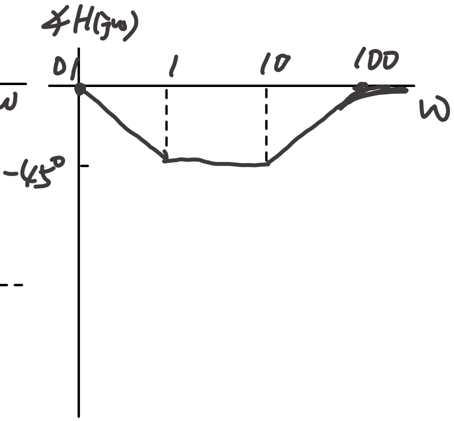
$\omega \leq 0.1$ $\angle H(j\omega) = 0$.

$\omega = 1$ $\angle H(j\omega) \approx -45^\circ$

$\omega = 10$. $\angle H(j\omega) \approx 45^\circ - 90^\circ = -45^\circ$

$\omega \geq 100$ $\angle H(j\omega) \approx 0^\circ$ (渐近)





(b) $H_{iv}(j\omega) = \dfrac{1 - j\frac{\omega}{10}}{1+j\omega} = \dfrac{-\frac{1}{10} - \frac{j\omega}{10} + \frac{11}{10}}{1+j\omega}$

$= -\frac{1}{10} + \frac{11}{10}\frac{1}{1+j\omega}$

$\therefore h_{iv}(t) = -\frac{1}{10}\delta(t) + \frac{11}{10}e^{-t}u(t)$

$G_{iv}(j\omega) = \left(-\frac{1}{10} + \frac{11}{10}\frac{1}{1+j\omega}\right)\left(\pi\delta(\omega) + \frac{1}{j\omega}\right)$

$G_{iv}(s) = \left(-\frac{1}{10} + \frac{11}{10}\frac{1}{s+1}\right)\frac{1}{s}$ （令 $s = j\omega$

$\therefore g_{iv}(t) = -\frac{1}{10}u(t) + \frac{11}{10}(1-e^{-t})u(t)$

阶跃: $= u(t) - \frac{11}{10}e^{-t}u(t)$

$H_{vi}(j\omega) = \dfrac{1 + j\frac{\omega}{10}}{1+j\omega} = \frac{1}{10} + \frac{9}{10}\frac{1}{1+j\omega}$

$\therefore h_{vi}(t) = \frac{1}{10}\delta(t) + \frac{9}{10}e^{-t}u(t)$

$G_{vi}(j\omega) = \left(\frac{1}{10} + \frac{9}{10}\frac{1}{1+j\omega}\right)\left(\pi\delta(\omega) + \frac{1}{j\omega}\right)$

$= \frac{1}{10}\frac{1}{j\omega} + \frac{9}{10}\left(\frac{1}{j\omega} - \frac{1}{j\omega+1}\right) + \frac{9\pi}{10}\delta(\omega) + \frac{1}{10}\pi\delta(\omega)$

$g_{vi}(t) = \frac{1}{10}u(t) + \frac{9}{10}u(t) + \frac{9}{10}e^{-t}u(t)$

$= u(t) + \frac{9}{10}e^{-t}u(t)$

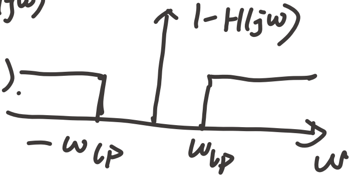
6.33.(a) $H(j\omega)=\begin{cases}1 & |\omega|<\omega_{lp} \\ 0 & |\omega|>\omega_{lp}\end{cases}$.

对图上反馈系统

$$Y(j\omega)=[1-H(j\omega)]X(j\omega)$$

$$=\begin{cases}1 & |\omega|>\omega_{lp} \\ 0 & |\omega|<\omega_{lp}\end{cases}\cdot X(j\omega)$$

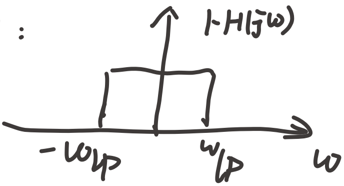
$1-H(j\omega)$ (a).



故系统相当于截止频率为 ω_{lp} 的高通滤波.

(b). $Y(j\omega)=[1-H(j\omega)]X(j\omega)$.

$1-H(j\omega)$:



$$Y(j\omega)=\begin{cases}1 & |\omega|<\omega_{lp} \\ 0 & |\omega|>\omega_{lp}\end{cases}\cdot X(j\omega)$$

故系统相当于截止频率 ω_{lp} 的低通滤波

(c) 则 $H(e^{j\omega}) = \sum_{k=-w_{LP}}^{w_{LP}} \delta(\omega - k\omega_0)$ 其中 $\omega_0 = 1$.

$\therefore Y(e^{j\omega}) = [1 - H(e^{j\omega})] X(e^{j\omega})$

当 $|\omega| < \omega_{LP}$ $\quad 1 - H(e^{j\omega}) = 0$. $\quad Y(e^{j\omega}) = 0$

$|\omega| > \omega_{LP}$ $\quad 1 - H(j\omega) = 1$ $\quad Y(e^{j\omega}) = X(e^{j\omega})$

$\therefore$ 是个理想离散时间高通滤波