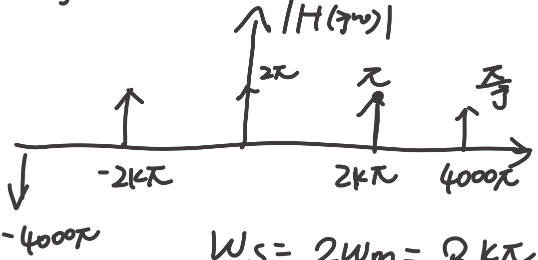
题7.3 $X(j\omega) = 2\pi\delta(\omega) + \pi[\delta(\omega-2000\pi)+\delta(\omega+2000\pi)]$

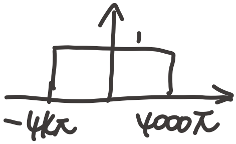
$+ \frac{\pi}{j}[\delta(\omega-4000\pi)-\delta(\omega+4000\pi)]$

画幅频



$\omega_s = 2\omega_m = 8k\pi$ rad/s

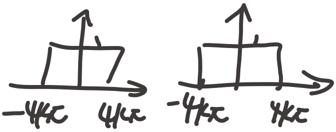
(2) $X(j\omega) =$



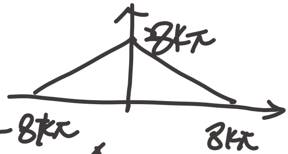
$\to \omega_s = 8k\pi$

一定采样大于8kπ.

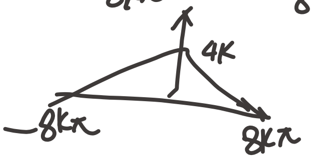
(3) $\left(\frac{\sin(4000\pi t)}{\pi t}\right)^2 \to \frac{1}{2\pi}$



$= \frac{1}{2\pi}$



$=$



ω

7.4题 奈率 $\omega_0 \to$ 带限 $\frac{1}{2}\omega_0 = |\omega_m|$

(1) $Y(j\omega) = X(j\omega)(1+e^{-j\omega})$

还是其最大频. 奈率为 ω_0。

(2). $Y(j\omega) = j\omega X(j\omega) \Rightarrow \omega_0$

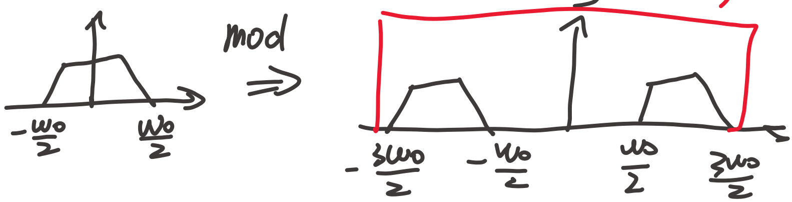
时移 or 微分并不改变

(3) $x(t)\ x(t) \xrightarrow{\mathcal{F}} \frac{1}{2\pi}[X(j\omega) * X(j\omega)]$

$\omega_M = 2\omega_m \Rightarrow \omega_0 = 2\omega_0$

(4) $X(j\omega) * \pi[\delta(\omega-\omega_0) + \delta(\omega+\omega_0)]$

$\boxed{\omega_M} = \frac{3}{2}\omega_0$



7.8. (1) $X(j\omega) = \sum_{k=0}^{5} \left(\frac{1}{2}\right)^k \frac{\pi}{j}\{[\delta(\omega-k\pi) - \delta(\omega+k\pi)]\}$

∴ $\omega_m = 5\pi = \frac{2\pi f_s}{2}$

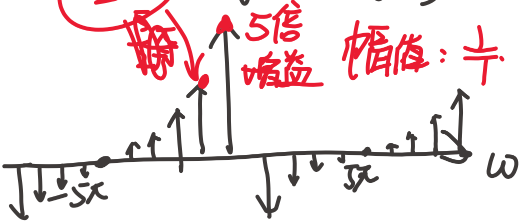
∴ 在 $\omega = 5\pi$ 时混叠

(2). 截 $f_c = \frac{\omega_s}{2} = 5\pi$. 会除去 $\omega = 5\pi$ 冲激

$\frac{2}{\pi}$ $X(j\omega) \cdot H(j\omega)$

幅值：$\frac{1}{\pi}$ 等周期延拓

5倍



增益 $T=0.2$ → 5倍

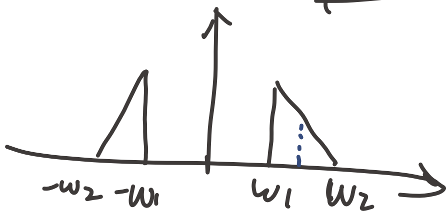
$$G(j\omega) = \sum_{0}^{4} \left(\frac{1}{2}\right)^{k} \frac{\pi}{j} \left[\delta(\omega+k\pi) - \delta(\omega-k\pi)\right]$$

7.21 $T=10^{-4}$ $f_s=\frac{1}{T}=10^{4}Hz$

要

7.27

$x(t) \rightarrow \boxed{x(t)e^{j\omega t}}$ 采样.

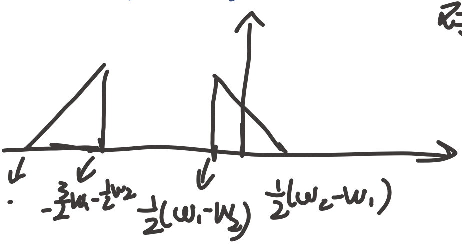


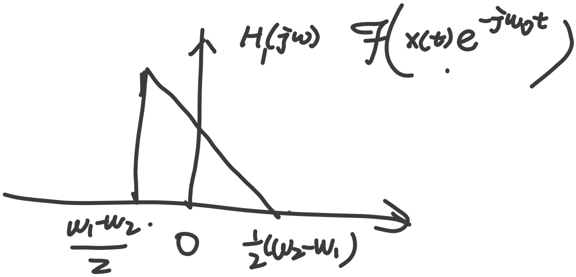
$x(t) \rightarrow \otimes \rightarrow \boxed{H_1(j\omega)} \rightarrow \otimes \rightarrow y(t)$

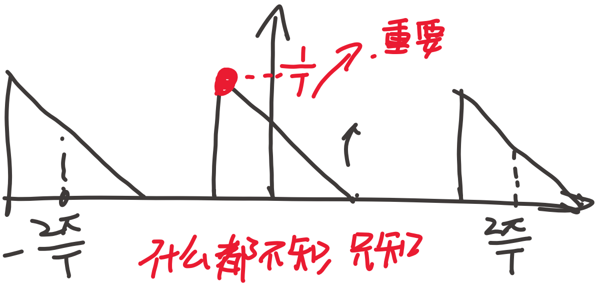
$e^{-j\omega_0 t}$ $p(t)=\sum_{-\infty}^{\infty}\delta(t-nT)$

$x(t)$ 频移 $\frac{1}{2}(\omega_1+\omega_2)$ 注意是左移

时中间 $\omega_m=\frac{1}{2}(\omega_2-\omega_1)$







什么都不知，只知

$\frac{2\pi}{T}$ 周期延拓、

$$\omega_m = \omega_2-\omega_1 \to \omega_s > 2\omega_m$$
$$= 2(\omega_2-\omega_1)$$
$$\omega_s = \frac{2\pi}{T} > 2(\omega_2-\omega_1)$$

理想下可以 $T < \frac{\pi}{\omega_2-\omega_1}$ 取得到。

取 $2\omega_m$ 为极限，工业不这么干就是。

(5) 滤完 → 频移 → 对称、

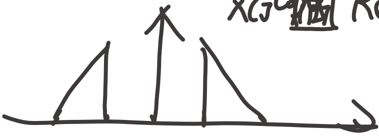
$x_p(t) \to \boxed{H_1(j\omega)} \to \otimes e^{-j\omega_0 t} \to Re[\cdot]$. 变成实信号后对称（共轭）

→ 图(b)中

$X(j\omega) \to x(t)$

$X(j\omega) = X^*(-j\omega)$

$X(j\omega)$ [illegible] $Re[x(t)]$



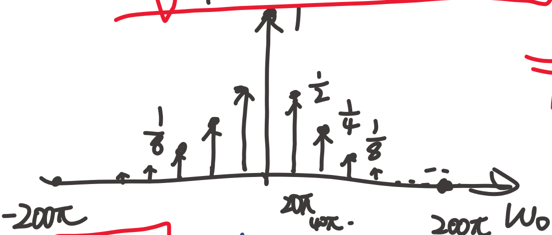
7.28

$$x(t) = \sum_{-\infty}^{\infty} \left(\frac{1}{2}\right)^k \cdot e^{+jk\omega_0 t} \qquad \omega_0 = 20\pi$$

$$x(t) \xrightarrow{H(j\omega)} \sum_{-\infty}^{\infty} H(jk\omega_0)\left(\frac{1}{2}\right)^k e^{jk\omega_0 t}$$

将 $k\omega_0 < 205\pi$ 保留 $K < 10.25$

$$= \sum_{-10}^{10} \left(\frac{1}{2}\right)^{|k|} e^{jk\omega_0 t}.$$



$\frac{1}{T}$ 采样后 $X_c(j\omega)$ 幅值 $\cdot \frac{1}{T}$

梳理

$$X_c(j\omega) = \sum_{-10}^{10} 2\pi \left(\frac{1}{2}\right)^{|k|} \delta(\omega - k\omega_0).$$

延拓 $2\pi \frac{1}{T} \delta(\omega - k\frac{2\pi}{T})$

$$P(j\omega) = \sum_{-\infty}^{\infty} \frac{1}{T} 2\pi \delta(\omega - \underbrace{\boxed{\frac{2\pi}{T}}}_{\omega_s} k) \qquad T = 5 \times 10^{-3}\,s$$

频

$$X_p(j\omega) = \frac{1}{2\pi} P(j\omega) * X_c(j\omega)$$

$\delta(t - nT)$ 与 $e^{-j\omega nT}$

$X_c(j\omega)$. 有个幅值

$X_p(j\omega) * X_c(j\omega)$ 后

得到东西是 $\boxed{X_c(j\omega) \text{ 幅的 } \frac{1}{T}}$

$$\frac{1}{T}\sum X_c\left(j\left(\omega-k\frac{2\pi}{T}\right)\right)$$

不用动

因 $X_p(j\omega) = \frac{1}{2\pi} P(j\omega) * \boxed{X_c(j\omega)}$

$$= \frac{1}{2\pi}\sum_{-\infty}^{\infty}\frac{2\pi}{T}\delta\left(\omega-k\frac{2\pi}{T}\right) \quad X_c(j\omega)$$

$$= \frac{1}{T}\sum_{-\infty}^{\infty} X_c\left(j\left(\omega-k\frac{2\pi}{T}\right)\right)$$

$$= \frac{1}{T}\sum_{k=-\infty}^{\infty} X_c[j(w-k\frac{2\pi}{T})]$$

时

$$x_c(t) = \sum_{-10}^{10} (\tfrac{1}{2})^k e^{jkw_0 t}$$

$w_0 T n$

$x[n] = x_c(nT) \Rightarrow x[n] = \sum_{-10}^{10} (\tfrac{1}{2})^k e^{jkw_0 nT}$

~~$x[n]$~~ $w_0 T = \Omega = \boxed{0.1\pi} = \boxed{\frac{2\pi}{N}}$.

$\therefore N = 20$.

(2) $\frac{2\pi}{N} = 0.1$. $x[n] = \sum_{-10}^{10} (\tfrac{1}{2})^k e^{jk0.1\pi n}$

在 $k=10$ 混叠加 $= \sum_{k=-9}^{9} (\tfrac{1}{2})^k \cdot e^{jk0.1\pi n}$

$$+ 2(\tfrac{1}{2})^{10} e^{j\pi n}$$

$\sum \delta(t - nT)$

$\sum a_k e^{jkw_0 t}$ $w_0 = \frac{2\pi}{T}$

$= \begin{cases} (\frac{1}{2})^k & 0 \sim 9 \\ \underline{(\frac{1}{2})^9} & 10 \end{cases}$

双倍.

$a_k = \frac{1}{T}$

$\therefore \sum \frac{1}{T} e^{jkw_0 t}$

$\xrightarrow{\mathcal{F}} \sum \frac{1}{T} 2\pi\, \delta(w - k\frac{2\pi}{T})$