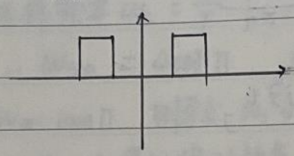
周子涵，2018011218014

第6章： 5、23、27.

5、$H(j\omega)=\begin{cases}1, & \omega_c \le |\omega| \le 3\omega_c \\ 0, & \text{otherwise}\end{cases}$

(a). $h(t)=\left(\frac{\sin\omega_c t}{\pi t}\right)g(t)$

$\frac{\sin\omega_c t}{\pi t}$ 的 fourier transform 为 $X(j\omega)=\begin{cases}1. & |\omega|<\omega_c \\ 0, & \text{otherwise}\end{cases}$



$H(j\omega)=H(j(\omega-2\omega_c))+H(j(\omega+2\omega_c))$

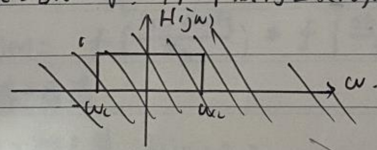
$\therefore h(t)=\frac{\sin\omega_c t}{\pi t}\cdot e^{j2\omega_c t}+\frac{\sin\omega_c t}{\pi t}e^{-j2\omega_c t}$

$\therefore g(t)=e^{j2\omega_c t}+e^{-j2\omega_c t}$

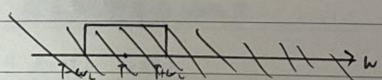
$\therefore g(t)=2\cos 2\omega_c t.$

(b). ω_c 增加时，单位冲激响应更向原点集中.

23、~~(a)~~



~~(b)~~



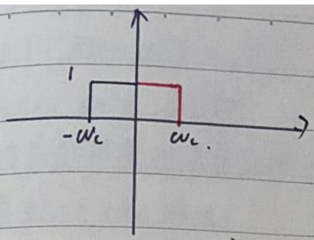
(a) $H_1(j\omega)=\begin{cases}1, & |\omega|<\omega_c \\ 0, & \text{otherwise}\end{cases}$ $\therefore h_1(t)=\frac{\sin\omega_c t}{\pi t}$

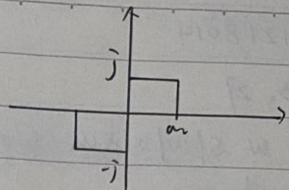
(b) $H_2(j\omega)=|H_1(j\omega)|e^{j\omega T}$

$= H(j\omega)e^{j\omega T}$

$\therefore h_2(t)=\frac{\sin[\omega_c(t+T)]}{\pi(t+T)}$

(c).





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

设 $X(j\omega) = \begin{cases} 1, & |\omega| < \frac{\omega_c}{2} \\ 0, & \text{otherwise} \end{cases}$ $\quad x(t) = \frac{\sin\frac{\omega_c}{2}t}{\pi t}.$

$$\therefore \cancel{H(j\omega)}\ h(t) = \frac{\sin\frac{\omega_c}{2}t}{\pi t}\left(j\, e^{j\frac{\omega_c}{2}t} + \frac{\sin\frac{\omega_c}{2}t}{\pi t}\, j\, e^{-j\frac{\omega_c}{2}t}\right]$$

$$= \frac{\sin\frac{\omega_c}{2}t}{\pi t} \cdot \left(-2\sin\frac{\omega_c}{2}t\right)$$

$$= -\frac{2\sin^2\frac{\omega_c}{2}t}{\pi t}$$

27. (a) $\frac{dy(t)}{dt} + 2y(t) = x(t)$

$$\therefore H(j\omega) = \frac{1}{2+j\omega}.$$

$$\measuredangle H(j\omega) = -\arctan\frac{\omega}{2}.$$

(b) $\tau(\omega) = (\measuredangle H(j\omega))' = \frac{2}{4+\omega^2}.$

(c) $Y(j\omega) = H(j\omega)X(j\omega)$

$$= \frac{1}{(1+j\omega)(2+j\omega)}$$

(d) $Y(j\omega) = \frac{1}{1+j\omega} - \frac{1}{2+j\omega}$

$$\therefore y(t) = (e^{-t} - e^{-2t})\, u(t)$$

(e) (i) $Y(j\omega) = \frac{1+j\omega}{(2+j\omega)^2}$

$Y(j\omega) = \frac{1}{2+j\omega} - \frac{1}{(2+j\omega)^2}$

$\therefore y(t) = e^{-2t}u(t) - te^{-2t}u(t)$

(ii) $Y(j\omega) = \frac{1}{1+j\omega}$

$y(t) = e^{-t}u(t)$

(iii) $Y(j\omega) = \frac{1}{(2+j\omega)^2(1+j\omega)}$

$Y(j\omega) = \frac{-1}{2+j\omega} + \frac{-1}{(2+j\omega)^2} + \frac{1}{1+j\omega}$

$\therefore y(t) = -e^{-2t}u(t) - te^{-2t}u(t) + e^{-t}u(t)$

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第7章 1、2、3、6、9.

1、$w_s = 10000\pi$.

$10000\pi > 2w_m$

$w_m < 5000\pi$

$\therefore X(jw)$在 $w \geq 5000\pi$ 时保证为0.

2、$w_c = 1000\pi$

采样频率 $w_s = \frac{2\pi}{T}$

$\therefore w_{sa} = 4000\pi$ $w_{sb} = 1000\pi$ $w_{sc} = 20000\pi$.

$w_m = 1000\pi$ 则要求 $w_s > 2000\pi$

$\therefore$ a, c 可以得到恢复.

3、(a). $|w| > 4000\pi$ 时, $X(jw) = 0$

$\therefore$ 奈奎斯特率为 8000π.

(b) $|w| > 4000\pi$ 时, $X(jw) = 0$

$\therefore$ 奈奎斯特率为 8000π.

(c) $X(t) = \left(\frac{\sin 4000\pi t}{\pi t}\right)\left(\frac{\sin 4000\pi t}{\pi t}\right)$

$\therefore X(jw) = \mathcal{F}\left\{\frac{\sin 4000\pi t}{\pi t}\right\} * \mathcal{F}\left\{\frac{\sin 4000\pi t}{\pi t}\right\}$,

为三角波

$|w| > 8000\pi$ 时, $X(jw) = 0$

$\therefore$ 奈奎斯特率为 16000π

6、$W(t) = X_1(t) \cdot X_2(t)$

$W(jw) = \frac{1}{2\pi} X_1(jw) * X_2(jw)$

$|w| > w_1 + w_2$ 时

$W(jw) = 0$.

$\therefore W_s = 2(w_1 + w_2)$

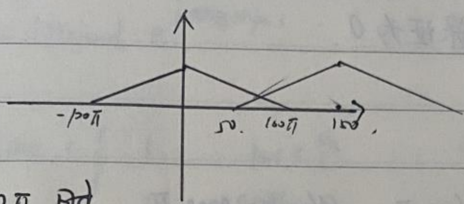
$\therefore T_{max} = \frac{\pi}{w_1 + w_2}$.

9、$x(t) = (\frac{\sin 50\pi t}{\pi t})^2$.

$|w| > 100\pi$ 时, $X(jw) = 0$.

$G(jw) = \frac{1}{T}\sum_{k=-\infty}^{+\infty} X(j(w - kw_s))$

$T = \frac{2\pi}{w_s} = \frac{1}{75}$



$\therefore w_0 = 50\pi$ 时

可确保 $G(jw) = 75X(jw)$

第8章 1, 3, 22, 28.

1、$Y(jw) = 2X(j(w - w_c))$

$y(t) = 2e^{jw_ct} x(t)$

$x(t) = y(t)\,m(t)$

$\therefore m(t) = \frac{1}{2}e^{-jw_ct}$.

3、$x'(t) = g(t)\cos 2000\pi t$.

$= \frac{1}{2} x(t) \sin(4000\pi t)$

$\therefore X'(jw) = \frac{1}{4\pi}X(jw) * \frac{\pi}{j}[\delta(w - 4000\pi) - \delta(w + 4000\pi)]$

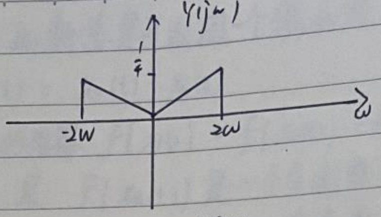
$= \frac{1}{4j}X(j(w - 4000\pi)) - \frac{1}{4j}X(j(w + 4000\pi))$

$\because X(jw) = 0, |w| > 2000\pi$.

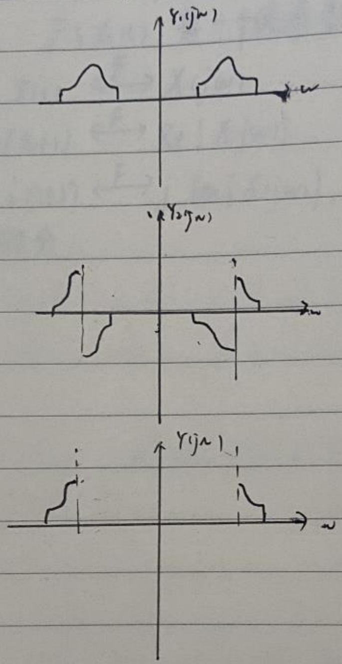
理想低通截止频率为 2000π

$\therefore y(t) = 0$.

22,



28. (a)



(b)