

7.22 解: 由已知, 得

$$Y(j\omega) = X_1(j\omega) X_2(j\omega)$$

$$\therefore |\omega| > 1000\pi \text{ 时}$$

$$Y(j\omega) = 0$$

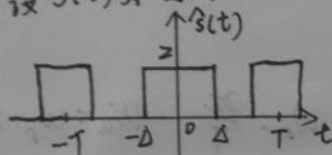
$$\therefore \text{奈奎斯特速率为: } 2 \times 1000\pi = 2000\pi \text{ 频}$$

$\therefore$  采样周期  $T$  的范围为:

$$\frac{2\pi}{2000\pi} = 10^{-3} \text{ s}$$

$$\text{即 } T < 10^{-3} \text{ s 即为所求}$$

7.24 解: (a) 设  $\hat{s}(t)$  如图所示。



$$\text{则 } s(t) = \hat{s}(t) - 1$$

$$\therefore S(j\omega) = \hat{S}(j\omega) - 2\pi f(\omega) = \sum_{k=-\infty}^{\infty} \frac{4 \sin(\frac{2\pi k \Delta}{T})}{k} f(\omega - k \frac{2\pi}{T}) - 2\pi f(\omega)$$

$\therefore$  当  $\Delta = \frac{T}{3}$  时, 有

$$S(j\omega) = \sum_{k=-\infty}^{\infty} \frac{4 \sin(\frac{2\pi k}{3})}{k} f(\omega - k \frac{2\pi}{T}) - 2\pi f(\omega)$$

由  $w(t) = s(t) * x(t)$  得

$$W(j\omega) = \frac{1}{2\pi} \sum_{k=-\infty}^{\infty} \frac{4 \sin(\frac{2\pi k}{3})}{k} X(j(\omega - \frac{k2\pi}{T})) - 2\pi X(j\omega)$$

$$\therefore \omega_m \leq \frac{\pi}{T} \Rightarrow T \leq \frac{\pi}{\omega_m}, \text{ 即为所求}$$

(b) 当  $\Delta = \frac{\pi}{4}$  时,

$$S(j\omega) = \sum_{k=-\infty}^{\infty} \frac{4 \sin(\frac{2\pi k}{4})}{k} f(\omega - \frac{2k\pi}{T}) - 2\pi f(\omega)$$

当  $k = 0, \pm 2, \pm 4, \pm 6, \dots$  时,  $S(j\omega) = 0$

$$\therefore \omega_m \leq \frac{2\pi}{T} \Rightarrow T \leq \frac{2\pi}{\omega_m}, \text{ 即为所求}$$

7.26. 解: 由已知, 有

$$P(j\omega) = \frac{2\pi}{T} f(\omega - \frac{k2\pi}{T})$$

$$X_p(t) = x(t)p(t)$$

$$\begin{aligned} \text{解: } X_p(j\omega) &= \frac{1}{2\pi} \{X(j\omega) * P(j\omega)\} \\ &= \frac{1}{T} X(j(\omega - \frac{2k\pi}{T})) \end{aligned}$$

$$\therefore 2\omega_1 - \omega_2 < \frac{2\pi}{T} - \omega_2 < \omega_2 \quad \text{时, 信号混叠}$$

$$\text{又: } 2\omega_1 - \omega_2 \geq 0$$

$$\text{解: } 0 \leq \frac{2\pi}{T} - \omega_2 \leq 2\omega_1 - \omega_2$$

$$\therefore T_{\max} = \frac{2\pi}{\omega_2}, \quad A = T, \quad \omega_2 = \frac{2\pi}{T}, \quad \omega_a = \omega_b - \omega_1$$

7.29. 解: 由已知有:

$$X_p(j\omega) = \frac{1}{T} \sum_{k=-\infty}^{\infty} X(j(\omega - \frac{2k\pi}{T}))$$

$\therefore X(e^{j\omega}), Y(e^{j\omega}), Y_p(j\omega), Y_c(j\omega)$  如下图所示。

