

$$3.12 \quad X(j\omega) = \int_0^1 (1-t) e^{-j\omega t} dt$$

$$= -\frac{j}{\omega} + \frac{1-e^{-j\omega}}{\omega^2}$$

$$x_1(t) = x(t-1) \longleftrightarrow e^{-j\omega} X(j\omega)$$

$$x_2(t) = x(-t-1) \longleftrightarrow e^{j\omega} X(-j\omega)$$

$$x_3(t) = 2x(1-\frac{t}{2}) \longleftrightarrow 4e^{-2j\omega} X(-\frac{j\omega}{2})$$

$$x_4(t) = x(t) + x(-t) \longleftrightarrow X(j\omega) + X(-j\omega)$$

$$x_5(t) = x(t) + x(1-t) \longleftrightarrow X(j\omega) + e^{-j\omega} X(-j\omega)$$

$$x_6(t) = (x(t) + x(1-t)) \cos \Omega_0 t$$

$$= (x(t) + x(-t)) \frac{e^{j\Omega_0 t} + e^{-j\Omega_0 t}}{2} + (x(t) - x(-t)) \frac{e^{j\Omega_0 t} - e^{-j\Omega_0 t}}{2j}$$

$$\longleftrightarrow \frac{1}{2} (X(j\omega) + X(-j\omega)) * \pi \delta(\omega - \Omega_0)$$

$$+ \frac{1}{2j} (X(j\omega) - X(-j\omega)) * \pi \delta(\omega + \Omega_0)$$

$$= \frac{1}{2} X(j(\omega - \Omega_0)) + \frac{1}{2} X(j(\Omega_0 - \omega))$$

$$+ \frac{1}{2} X(j(\omega + \Omega_0)) + \frac{1}{2} X(j(-\Omega_0 - \omega))$$

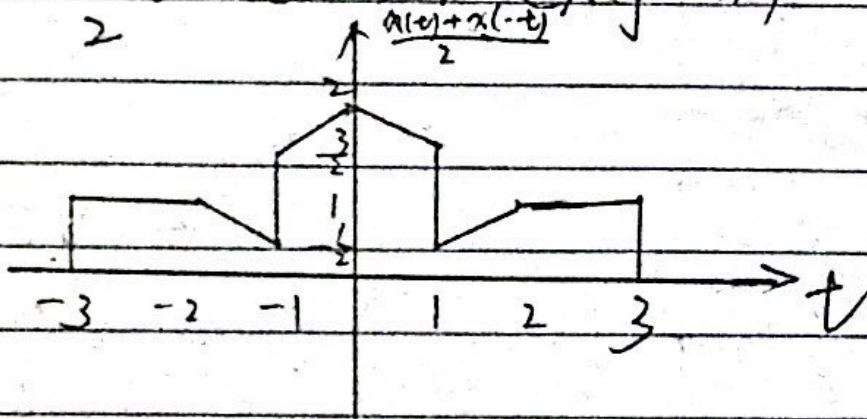
$$3.13 (a) X(0) = \int_{-\infty}^{+\infty} x(t) dt = 7$$

$$(b) \int_{-\infty}^{\infty} X(j\omega) d\omega = 2\pi X(0) = 1$$

$$(c) \int_{-\infty}^{\infty} X(j\omega) \frac{\sin \omega}{\omega} e^{j2\omega} d\omega = 2\pi (x(t) * (u(t+1) - u(t-1))) \Big|_{t=2} \\ = 2\pi \int_1^3 x(t) dt \\ = 7\pi$$

$$(d) \int_{-\infty}^{\infty} |X(j\omega)|^2 d\omega = 2\pi \int_{-\infty}^{\infty} |x(t)|^2 dt = \frac{76}{3}\pi$$

$$(e) \frac{x(t) + x(-t)}{2} \longleftrightarrow \text{Re}(X(j\omega))$$



3.15 (a) $\operatorname{Re}(X(j\Omega)) = 0 \Leftrightarrow x(t)$ 为奇函数

\therefore 图 (a), (b) 满足

(b) $\operatorname{Im}(X(j\Omega)) = 0 \Leftrightarrow x(t)$ 为偶函数

\therefore 图 (d), (f) 满足

(c) 即平移 a 后为偶函数

\therefore 图 (a), (c), (d), (f) 满足

(d) 即 $x(0) = 0$

\therefore 图 (a), (b), (c), (e), (f) 满足

(e) $x'(0) = 0$

\therefore 图 (c), (d), (e), (f) 满足

(f) 即由冲激函数线性组合得到

\therefore 图 (c) 满足

3.17 $H(j\omega) = u(\omega - 2\pi) - u(\omega + 2\pi)$

$$(1) X(j\omega) = \pi(\delta(\omega - \pi) + \delta(\omega + \pi)) + \frac{2\pi}{j}(\delta(\omega - \frac{3}{2}\pi) - \delta(\omega + \frac{3}{2}\pi))$$

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

$$\therefore y(t) = x(t) = \cos \pi t + 2\sin \frac{3}{2}\pi t$$

$$(2) X(j\omega) = \frac{1}{2\pi} \pi(\delta(\omega - \pi) + \delta(\omega + \pi)) * \pi(\delta(\omega - 2\pi) + \delta(\omega + 2\pi))$$

$$= \frac{\pi}{2}(\delta(\omega - 3\pi) + \delta(\omega - \pi) + \delta(\omega + \pi) + \delta(\omega + 3\pi))$$

$$Y(j\omega) = X(j\omega)H(j\omega) = \frac{\pi}{2}(\delta(\omega - \pi) + \delta(\omega + \pi))$$

$$\therefore y(t) = \frac{1}{2} \cos \pi t$$

$$(3) y(t) = \sum_{k=-\infty}^{\infty} \frac{\sin 2\pi(t - \frac{10}{3}k)}{\pi(t - \frac{10}{3}k)} \quad (?)$$

$$3.28 \text{ (a)} \quad j\omega Y(j\omega) + 2Y(j\omega) = X(j\omega)$$

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

$$h(t) = \frac{1}{2\pi} \int_{-\infty}^{\infty} H(j\omega) e^{j\omega t} d\omega = e^{-2t} u(t)$$

$$\text{(b)} \quad X(j\omega) = \frac{1}{1+j\omega}$$

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

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

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

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

$$= e^{-2t} u(t) - t e^{-2t} u(t)$$

$$\text{(2)} \quad Y(j\omega) = \frac{3+j\omega}{(1+j\omega)(2+j\omega)} = \frac{2}{1+j\omega} - \frac{1}{2+j\omega}$$

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

$$\text{(3)} \quad Y(j\omega) = \frac{1}{(1+j\omega)(2+j\omega)^2} = \frac{1}{2+j\omega} \left(\frac{1}{1+j\omega} - \frac{1}{2+j\omega} \right)$$

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

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

补 3.17 (3)

$$x(t) = \sum_{k=-\infty}^{+\infty} \delta(t - \frac{10}{3}k) = \sum_{k=-\infty}^{+\infty} A_k e^{jk\omega_0 t}$$

$$T_0 = \frac{10}{3}, \omega_0 = \frac{2\pi}{T_0} = \frac{3}{5}\pi, A_k = \frac{3}{10} \int_0^{\frac{10}{3}} \delta(t) e^{-jk\omega_0 t} dt = \frac{3}{10}$$

$$\Rightarrow x(t) = \frac{3}{10} \sum_{k=-\infty}^{+\infty} e^{jk\frac{3\pi}{5}t}$$

$$\Rightarrow X(j\omega) = \frac{3}{5}\pi \sum_{k=-\infty}^{+\infty} \delta(\omega - \frac{3\pi}{5}k)$$

$$\Rightarrow Y(j\omega) = X(j\omega)H(j\omega) = \frac{3}{5}\pi(\delta(\omega - \frac{9}{5}\pi) + \delta(\omega - \frac{6}{5}\pi) + \delta(\omega - \frac{3}{5}\pi) + \delta(\omega) + \delta(\omega + \frac{3}{5}\pi) + \delta(\omega + \frac{6}{5}\pi) + \delta(\omega + \frac{9}{5}\pi))$$

$$\Rightarrow y(t) = \frac{3}{5}(\frac{1}{2} + \cos \frac{3}{5}\pi t + \cos \frac{6}{5}\pi t + \cos \frac{9}{5}\pi t)$$