

5.21 (a) 解: 由已知, 得

$$x[n] = u[n-2] - u[n-6] = \delta[n-2] + \delta[n-3] + \delta[n-4] + \delta[n-5]$$

$$\therefore X(e^{j\omega}) = e^{-2j\omega} + e^{-3j\omega} + e^{-4j\omega} + e^{-5j\omega}$$

5.22 (c) 解: 由已知, 得

$$x[n] = \frac{1}{2\pi} \int_{-\pi}^{\pi} e^{-\frac{j\omega}{2}} e^{j\omega n} d\omega = \frac{(-1)^{n+1}}{\pi(n-\frac{1}{2})}$$

5.23 解: (a) $\therefore X(e^{j\omega}) = \sum_{n=-\infty}^{+\infty} x[n] e^{-j\omega n}$

$$\therefore X(e^{j0}) = \sum_{n=-\infty}^{+\infty} x[n] = 6$$

(b) $\therefore y[n] = x[n+2]$ 为偶信号

$\therefore Y(e^{j\omega})$ 是实偶变换

$$\text{则 } Y(e^{j\omega}) = e^{j2\omega} X(e^{j\omega})$$

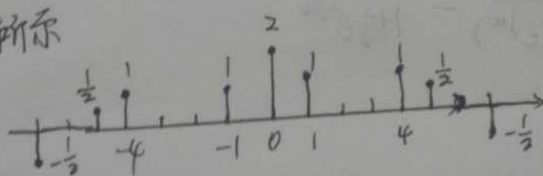
$$\therefore X(e^{j\omega}) = e^{-j2\omega}$$

(c) $\therefore 2\pi x[0] = \int_{-\pi}^{\pi} X(e^{j\omega}) d\omega$

$$\therefore \int_{-\pi}^{\pi} X(e^{j\omega}) d\omega = 4\pi$$

(d) $X(e^{j\pi}) = \sum_{n=-\infty}^{+\infty} x[n] (-1)^n = 2$

(e) 如图所示



(f) (i) $\int_{-\infty}^{+\infty} |X(e^{j\omega})|^2 d\omega = 2\pi \sum_{n=-\infty}^{+\infty} |x[n]|^2 = 28\pi$

(ii) $\therefore nx[n] \xrightarrow{FT} \frac{dX(e^{j\omega})}{d\omega}$

$$\int_{-\infty}^{+\infty} \left| \frac{dX(e^{j\omega})}{d\omega} \right|^2 d\omega = 2\pi \sum_{n=-\infty}^{+\infty} |n|^2 |x[n]|^2 = 316\pi$$

5.29 解: (a)(i)
$$h[n] \xleftrightarrow{\text{FT}} H(e^{j\omega}) = \frac{1}{1 - \frac{1}{2}e^{-j\omega}}$$

$$\therefore Y(e^{j\omega}) = X(e^{j\omega})H(e^{j\omega})$$

且 $X(e^{j\omega}) = \frac{1}{1 - \frac{3}{4}e^{-j\omega}}$

$$\therefore Y(e^{j\omega}) = \left[\frac{1}{1 - \frac{3}{4}e^{-j\omega}} \right] \left[\frac{1}{1 - \frac{1}{2}e^{-j\omega}} \right]$$

$$= \frac{-2}{1 - \frac{1}{2}e^{-j\omega}} + \frac{3}{1 - \frac{3}{4}e^{-j\omega}}$$

(c) 由已知得

$$Y(e^{j\omega}) = X(e^{j\omega})H(e^{j\omega}) = -3e^{-j\omega} - e^{j\omega} + 1 - 2e^{-j2\omega} + 6e^{-j\omega} + 2e^{-j2\omega}$$

$$- 2e^{-j3\omega} + 4e^{-j5\omega} + 3e^{j5\omega} + e^{j4\omega} - e^{j3\omega} + 2e^{j\omega}$$

$$\therefore y[n] = 3f[n+5] + f[n+4] - f[n+3] - 3f[n+2] + f[n+1] + f[n]$$

$$+ 6f[n-1] - 2f[n-3] + 4f[n-5]$$

5.33(a) 解:
$$H(e^{j\omega}) = \frac{Y(e^{j\omega})}{X(e^{j\omega})} = \frac{1}{1 + \frac{1}{2}e^{-j\omega}}$$