2.38)

$x(t) \begin{cases} 1 & (-\frac{T_0}{4} \le t \le \frac{T_0}{4}) \\ 0 \end{cases}$

a) $x(t) = A\Pi\left(\frac{2t}{T_0}\right)\cos w_0 t$

$w_0 T_0 = 2\pi$

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

$\omega = 2\pi f$

F.T 모듈라이존에 의해,

$\tau = \frac{T_0}{2}$

$$X(f) = \frac{1}{2}X(f-f_0) + \frac{1}{2}X(f+f_0)$$

$$= \frac{T_0}{2} \times A \times \left\{\frac{1}{2}\operatorname{sinc}\left(\frac{T_0}{2}(f-f_0)\right) + \frac{1}{2}\operatorname{sinc}\left(\frac{T_0}{2}(f+f_0)\right)\right\}$$

$$= \frac{T_0}{4} \cdot A \cdot \left\{\operatorname{sinc}\left(\frac{f}{2f_0} - \frac{1}{2}\right) + \operatorname{sinc}\left(\frac{f}{2f_0} + \frac{1}{2}\right)\right\}$$

b) F.T의 선형성원리에 의해, (a)결과에 $\frac{1}{2}A\Pi\left(\frac{2t}{T_0}\right)$의 F.T를 더하면된다.

$$\therefore X(f) = \frac{T_0}{4} \cdot 4 \cdot \operatorname{sinc}\left(\frac{1}{2f_0}\right) + \frac{T_0}{4} \cdot A\left\{\operatorname{sinc}\left(\frac{f}{2f_0} - \frac{1}{2}\right) + \operatorname{sinc}\left(\frac{f}{2f_0} + \frac{1}{2}\right)\right\}$$

c)

$$\underline{P(nf_0) = \frac{AT_0}{4}\left\{\operatorname{sinc}\left(\frac{n-1}{2}\right) + \operatorname{sinc}\left(\frac{n+1}{2}\right)\right\}}$$

b2.151

$\operatorname{sinc}(x) = \frac{\sin x}{x}$

$$P(f) = X(f) = \sum_{n=-\infty}^{\infty} f_s \; P(nf_s)\,\delta(f - nf_s) \qquad f_s \to f_0$$

$$= \sum_{n=-\infty}^{\infty} f_s \frac{AT_0}{4}\left\{\operatorname{sinc}\left(\frac{n-1}{2}\right) + \operatorname{sinc}\left(\frac{n+1}{2}\right)\right\}\underline{\delta(f - nf_0)}$$

$n=0 \rightarrow$ $\quad n = 1, -1$

$$= \delta(f)\frac{4}{\pi} + \frac{A}{4}\delta(f-f_0) + \frac{A}{4}\delta(f+f_0) + \frac{A}{3\pi}\delta(f-f_0) + \frac{A}{3\pi}\delta(f+f_0)$$

$+ \cdots$

2.48) $H(f) = \Pi\left(\frac{f}{2B}\right) = \begin{cases} 1 & |f| \le B \\ 0 & \end{cases}$

$$x(t) = 2W \operatorname{sinc}(2Wt) = 2W \frac{\sin(2Wt)}{2Wt}$$

$$H(\omega) = \frac{Y(\omega)}{X(\omega)} = |H(\omega)| e^{j\angle H(\omega)}$$

$$Y(f) = H(f)\,X(f) \qquad X(f) = \Pi\left(\frac{f}{2W}\right)$$

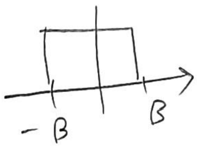
$$= \Pi\left(\frac{f}{2B}\right) \cdot \Pi\left(\frac{f}{2W}\right)$$

a. $W < B$

$$Y(f) = \Pi\left(\frac{f}{2W}\right)$$

b. $W > B$

$$Y(f) = \Pi\left(\frac{f}{2B}\right)$$



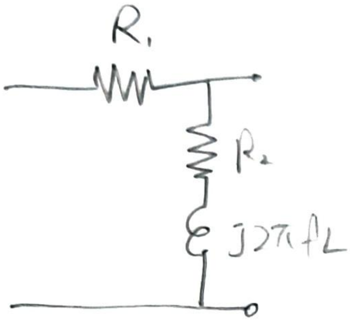
c. $W > B$ 일 때 distortion을 겪는다.

Input 스펙트럼과 output 스펙트럼이 같다.

$y(t) = 2B \operatorname{sinc}(2Bt)$

2.50)

①



$$y(t) = x(t) \cdot \frac{R_2 + j2\pi fL}{R_1 + (R_2 + j2\pi fL)}$$

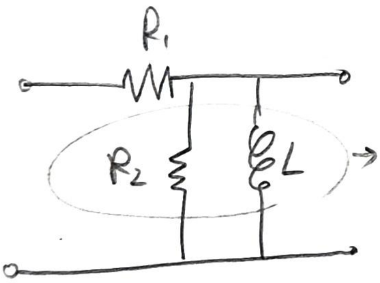
$$H(f) = \frac{R_2 + j2\pi fL}{R_1 + R_2 + j2\pi fL}$$

$$= 1 - \frac{R_1 / L}{\frac{R_1 + R_2}{L} + j2\pi f}$$

푸리에 역변환 표에 의해,

$$h(t) = \delta(t) - \frac{R_1}{L} \exp\left(-\frac{R_1 + R_2}{L} t\right) u(t)$$

②



$$\frac{R_2 L}{R_2 + L} = \frac{2\pi fL \cdot R_2}{R_2 + 2\pi fL}$$

$$H(f) = \frac{\frac{2\pi fL \cdot R_2}{R_2 + 2\pi fL}}{R_1 + \frac{2\pi fL \cdot R_2}{R_2 + 2\pi fL}} = \frac{2\pi fL \cdot R_2}{R_1(R_2 + 2\pi fL) + 2\pi fL \cdot R_2}$$

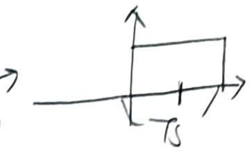
$$= 1 - \frac{R_1 R_2 + 2\pi fL \cdot R_1}{R_1 R_2 + (R_1 + R_2) 2\pi fL} = 1 - \frac{\frac{1}{L}\left(\frac{R_1 R_2}{R_1 + R_2}\right)}{\frac{1}{L}\left(\frac{R_1 R_2}{R_1 + R_2}\right) + 2\pi f}$$

$$h_2(t) = \frac{R_2}{R_1 + R_2}\left[\delta(t) - \frac{R_1 R_2}{(R_1 + R_2)} \times \frac{1}{L} \exp\left(-\frac{R_1 R_2}{(R_1 + R_2)} \cdot \frac{1}{L} \cdot t\right) u(t)\right]$$

2.68

a. $y(t) = \int_{-\infty}^{\infty} x(\lambda) h(t-\lambda)\, d\lambda$

$\Pi\left[(t - \frac{1}{2}T_s / T_s\right]$



$\hookrightarrow h(t) = u(t) - u(t-T)$

$$x_\delta(t) = \sum_{m=-\infty}^{\infty} x(mT_s)\, \delta(t - mT_s)$$

$$y(t) = \int_{-\infty}^{\infty} \sum_{m=-\infty}^{\infty} x(mT_s)\, \delta(k - mT_s)\, h(t-k)\, dk$$

$$= \sum_{m=-\infty}^{\infty} x(mT) \underbrace{\int_{-\infty}^{\infty} \delta(k - mT)\, h(t-k)\, dk}_{h(t-mT_s)}$$

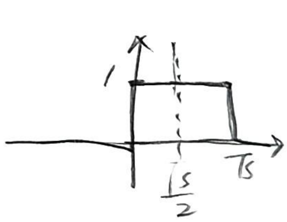
$$y(t) = \sum_{m=-\infty}^{\infty} x(mT)\, h(t - mT_s)$$

$$= \sum_{m=-\infty}^{\infty} x(mT_s)\{u(t) - u(t-T_s)\} = \sum_{m=0}^{T_s} x(mT_s)$$

신호의 bandwidth 보다 샘플링 주파수가 더 클때이다.

b. $Y(f) = X_\delta(f)\, H(f)$

$$h(t) = \Pi\left[\frac{t - \frac{1}{2}T_s}{T_s}\right]$$



$$H(f) = \mathrm{sinc}(T_s f)$$

$$Y(f) = H(f)\, X(f)$$

$$= \mathrm{sinc}(T_s f) \sum_{n=-\infty}^{\infty} X(f - nf_s)\, e^{-j\pi f T_s}$$

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

$w_0 = 2\pi f$

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

$f_s = \frac{1}{T_s} > w_0$

$T_s < \frac{1}{w_0}$