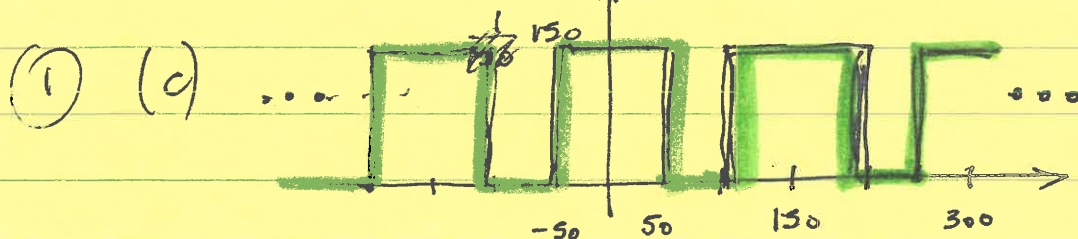


251-S'13 - HWK #4

1/2

$$x(t) = 100 \operatorname{sinc}(100t) \longleftrightarrow \Pi\left(\frac{f}{100}\right), \quad f_{s, \min} = 2W = 100 \text{ (a)}$$

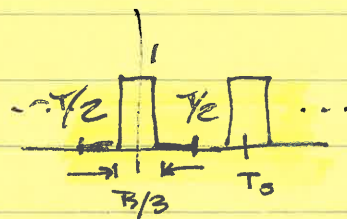
$$f_s = 150 \text{ (b)}$$



$$x_s(t) = f_s \sum_{n=-\infty}^{\infty} x(t - n f_s)$$

②

$$x_s(t) = x(t) \sum_{n=-\infty}^{\infty} \Pi\left(\frac{t - n T_s}{\tau}\right)$$



$$X_s(f) = X(f) * \sum_{n=-\infty}^{\infty} \frac{1}{3} \operatorname{sinc}\left(\frac{n}{3}\right) \delta(f - n f_s)$$

$$\rightarrow X_s(f) = \frac{1}{3} \sum_{n=-\infty}^{\infty} \operatorname{sinc}\left(\frac{n}{3}\right) X(f - n f_s)$$

FS coefficient

$$x_n = \frac{1}{T} \int_{-T/2}^{T/2} x(t) e^{j 2\pi \frac{n}{T} t} dt = \frac{1}{T} \int_{-T/2}^{T/2} e^{j 2\pi \frac{n}{T} t} dt$$

$$= \frac{\tau}{T} \operatorname{sinc}\left(\frac{n\tau}{T}\right), \quad \tau = \frac{T_s}{3} : \boxed{x_n = \frac{1}{3} \operatorname{sinc}\left(\frac{n}{3}\right)}$$

$$(3) \quad x_s(t) = \sum_{n=-\infty}^{\infty} x(nT_s) \Pi\left(\frac{t-nT_s}{\tau}\right)$$

$$= \sum_{n=-\infty}^{\infty} \left[x(t) \delta(t-nT_s) \right] * \Pi\left(\frac{t}{\tau}\right)$$

$$= \left[x(t) \sum_{n=-\infty}^{\infty} \delta(t-nT_s) \right] * \Pi\left(\frac{t}{\tau}\right)$$

$$\longleftrightarrow \left[f_s \sum_{n=-\infty}^{\infty} X(f-nf_s) \right] \tau \operatorname{sinc}(\tau f)$$

$$x_s(t) = \sum_{n=-\infty}^{\infty} x(nT_s) \Pi\left(\frac{t-nT_s}{\tau}\right)$$

$$= \sum_{n=-\infty}^{\infty} x(nT_s) \left[\delta(t-nT_s) * \Pi\left(\frac{t}{\tau}\right) \right]$$

$$= \sum_{n=-\infty}^{\infty} \left[x(t) \delta(t-nT_s) \right] * \Pi\left(\frac{t}{\tau}\right)$$

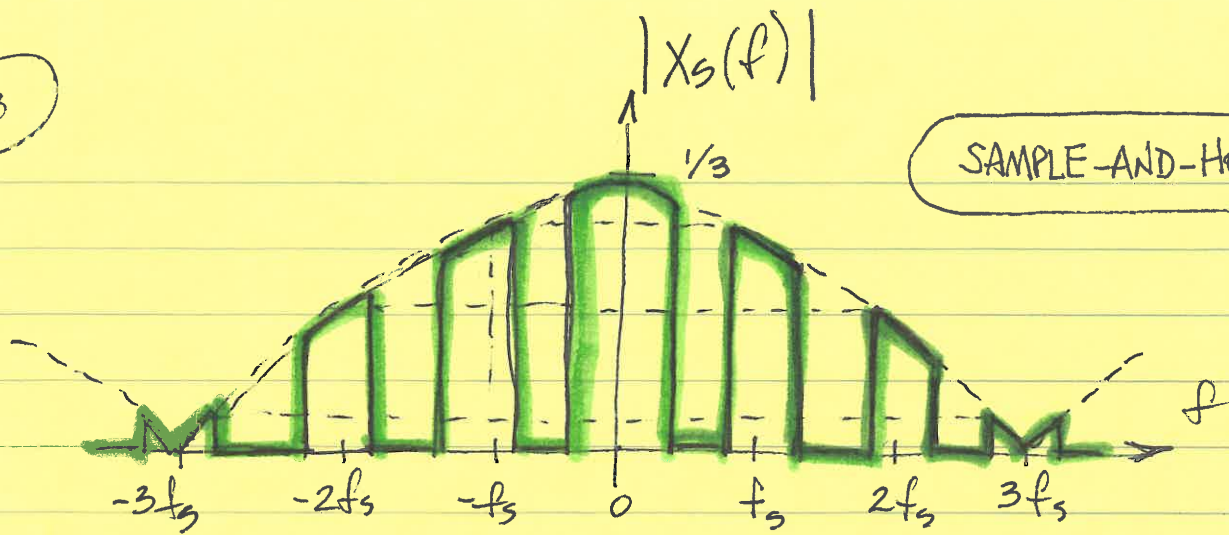
$$\longleftrightarrow X_s(f) = \left[f_s \sum_{n=-\infty}^{\infty} X(f-nf_s) \right] \cdot \tau \operatorname{sinc}(\tau f)$$

$$= \frac{1}{3} \left[\sum_{n=-\infty}^{\infty} X(f-nf_s) \right] \sin(\tau f), \quad \tau = \frac{T_s}{3} = \frac{1}{3f_s}$$

$$\Rightarrow \left[X_s(f) = \frac{1}{3} \operatorname{sinc}\left(\frac{f}{3f_s}\right) \sum_{n=-\infty}^{\infty} X(f-nf_s) \right]$$

③

3/3

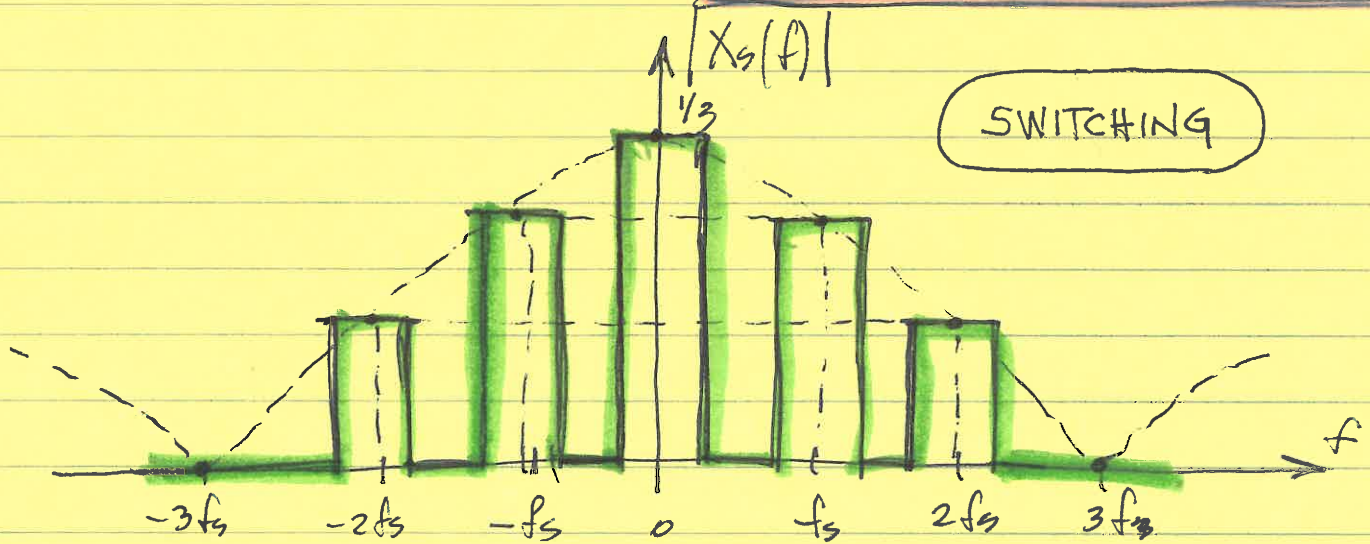


SAMPLE-AND-HOLD

②

$$x_s(t) = x(t) \sum_{n=-\infty}^{\infty} \Pi\left(\frac{t - nT_s}{\tau}\right) \leftrightarrow X_S(f) = X(f) * \frac{1}{3} \sum_{n=-\infty}^{\infty} \text{sinc}\left(\frac{n}{3}\right) \delta(f - nf_s)$$

$$X_S(f) = \frac{1}{3} \sum_{n=-\infty}^{\infty} \text{sinc}\left(\frac{n}{3}\right) X(f - nf_s)$$



SWITCHING