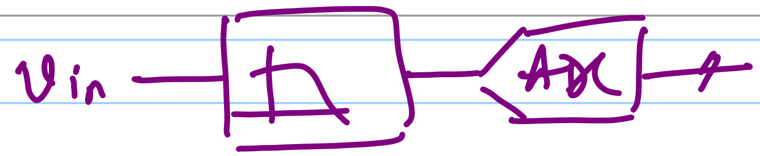
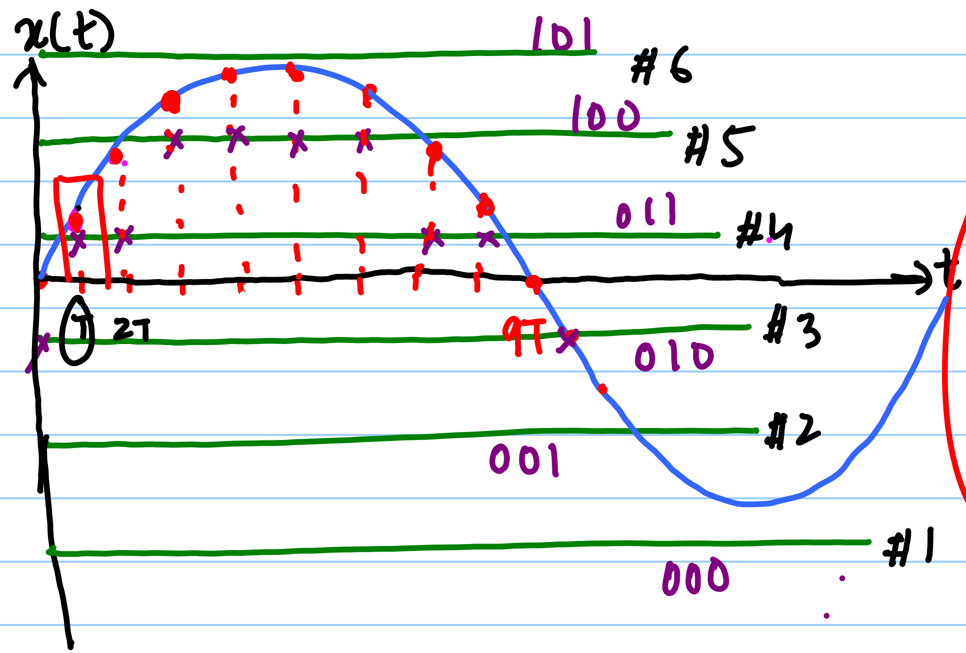
Note Title 13-04-2021

lecture # 32

Analog-to-digital Converter (ADC)



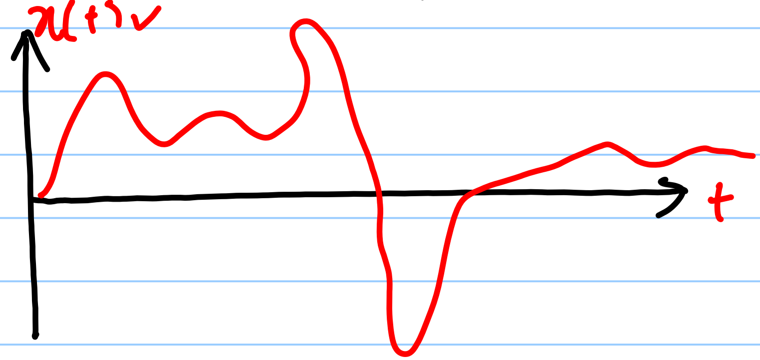


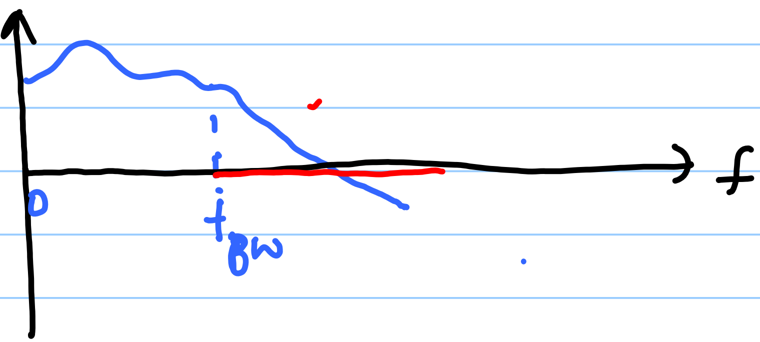
$$x_s(nT) = x(t = nT)$$

$$0, T, 2T, 3T \ldots$$

$$x(t) = 1 . \sin(2\pi f_0 t)$$

$$x_s(nT) = \sin(2\pi f_0 (nT))$$

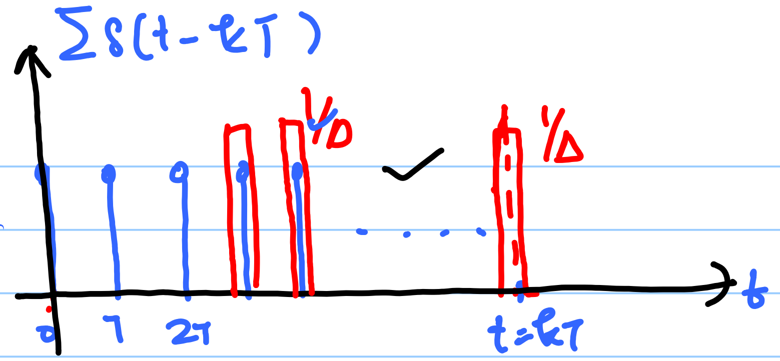




- Sampling
- Digitization (Quantization)

$$x_s(t) = x[nT]$$

$$= x(t) \times \sum_{k=-\infty}^{\infty} \delta(t - kT)$$



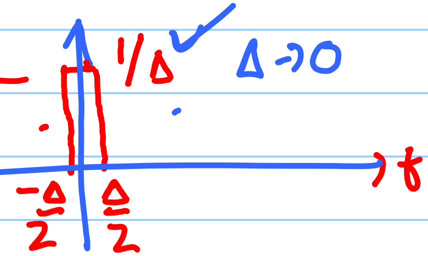
$$\times \sum_{k=-\infty}^{\infty} \delta(t - kT)$$

$\delta(t-kT) = 1$ for $t = kT$,

$= 0$ otherwise

$$\boxed{\int_{t=-\infty}^{\infty} \delta(t-kT)\, dt = 1}$$

$$\int \delta(t)\, dt = 1 \quad \Delta \to 0$$



$k = 2$

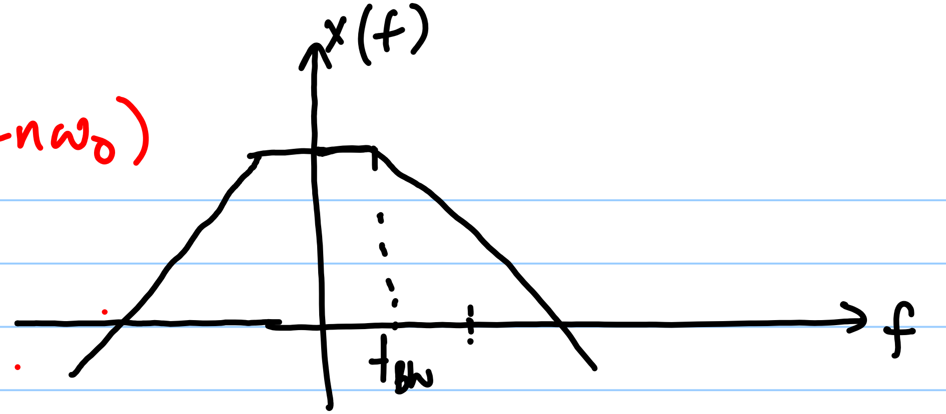
$\delta(t-2T) = 1$

for $t = 2T$

$$x_s(t) = x(t) \times \underbrace{\frac{1}{T} \sum_{n=-\infty}^{\infty} e^{jn\omega_0 t}}$$ where $\omega_0 = \frac{2\pi}{T}$

$$= \frac{1}{T} \sum_{n=-\infty}^{\infty} x(t)\, e^{jn\omega_0 t}.$$

$$X_s(\omega) = X(\omega) * \frac{1}{T}\sum_{n=-\infty}^{\infty} 2\pi\,\delta(\omega - n\omega_0)$$

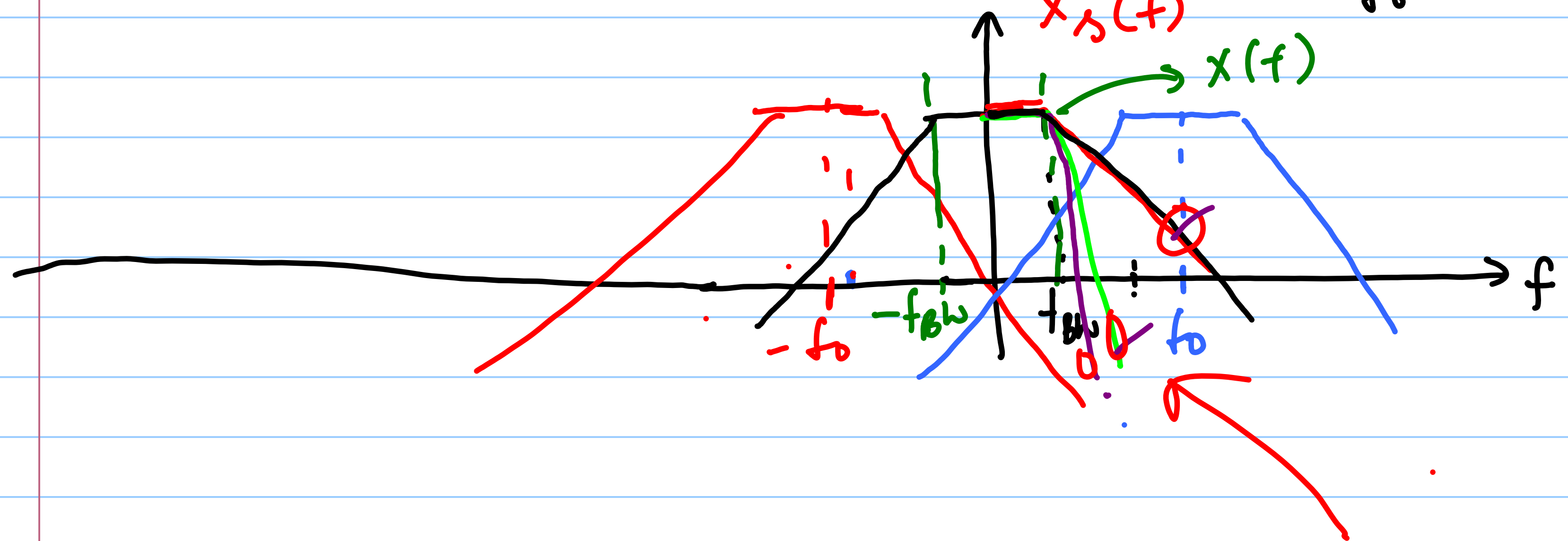


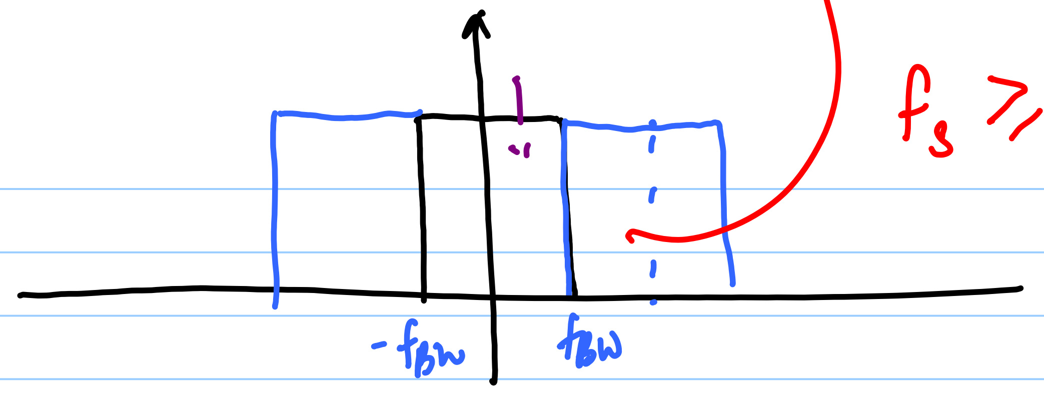
$$= \frac{1}{T}\sum_{n=-\infty}^{\infty} X(\omega - n\omega_0),$$

$$= \frac{1}{T}\sum_{n=-\infty}^{\infty} X\left(2\pi\,(f - nf_0)\right)$$

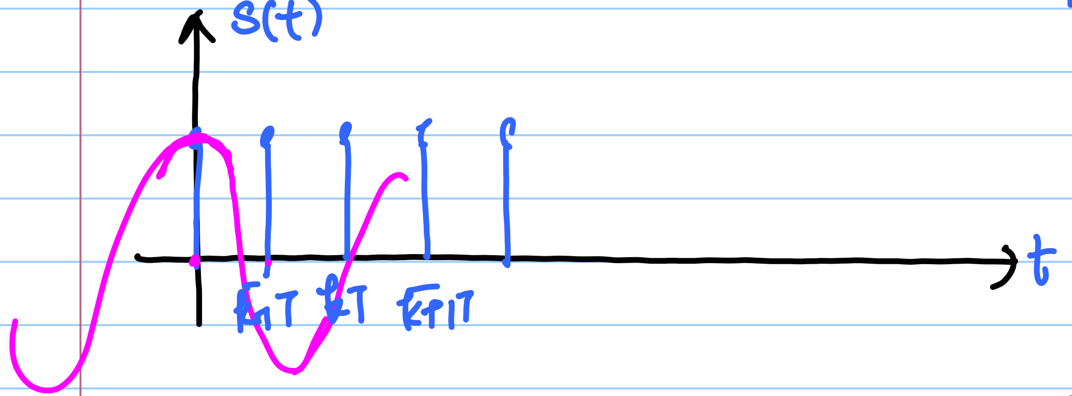
$$\frac{1}{T}X(f), \quad \frac{1}{T}X\left(2\pi(f - f_0)\right), \quad \frac{1}{T}X\left(2\pi(f + f_0)\right)$$

$T = \frac{1}{f_0}$





$f_s \geq 2 f_{BW}$

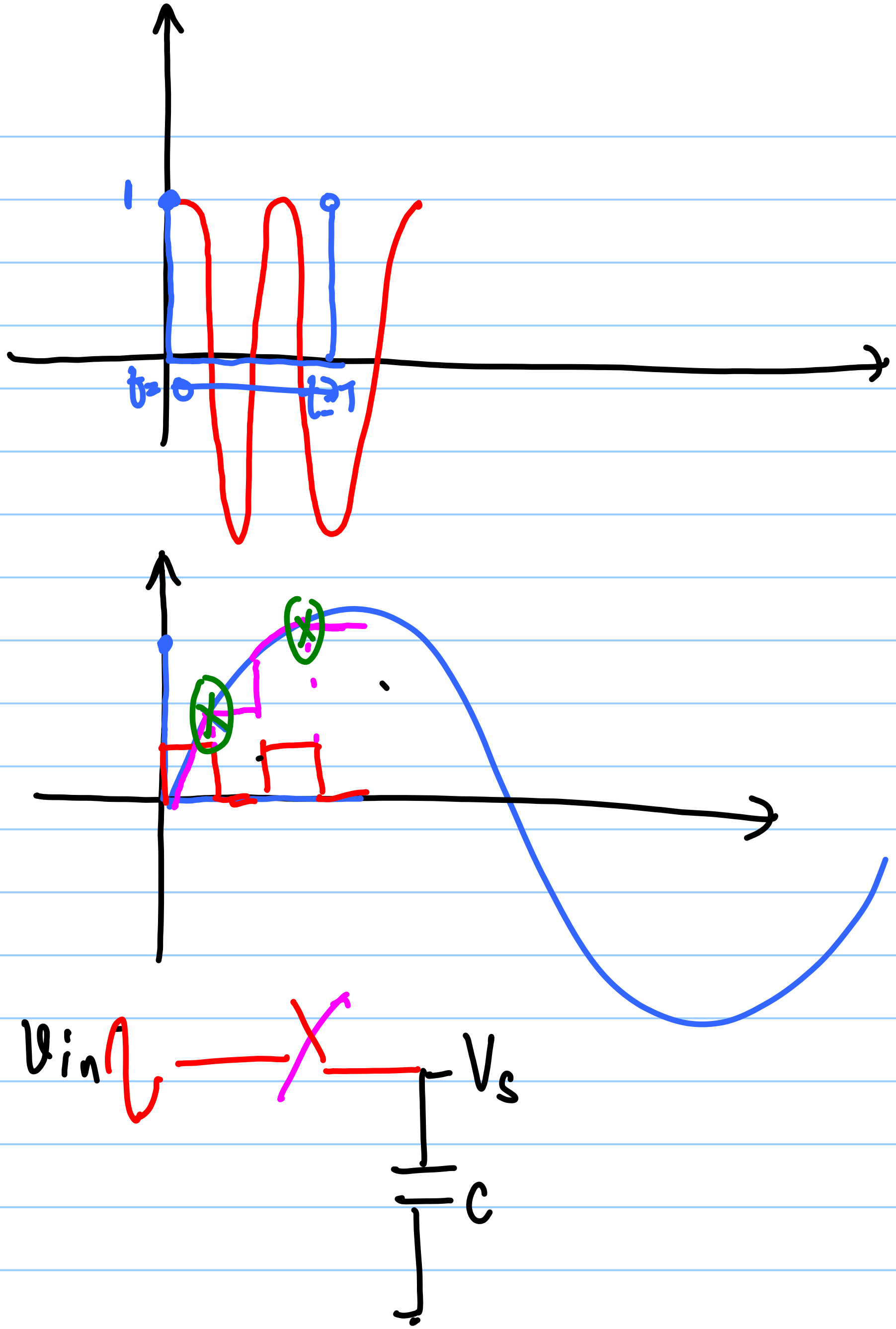


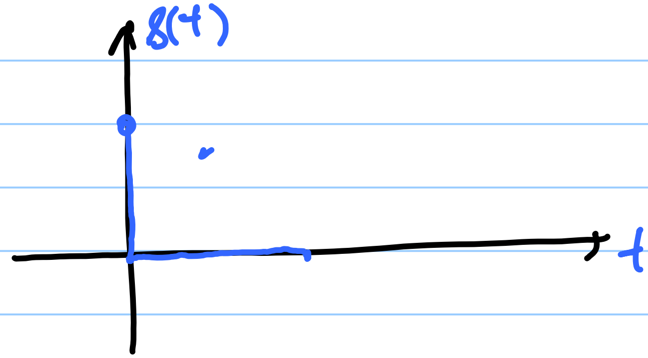
$$s(t) = \sum a_n \cos(n\omega_0 t) + b_n \sin(n\omega_0 t)$$
$$= \sum c_n e^{jn\omega_0 t}$$

$$\int_0^T s(t) \cdot \cos(n\omega_0 t) \cdot dt = \sum \int a_n \cos(n\omega_0 t) \cos(n\omega_0 t) \cdot dt + b_n \sin(n\omega_0 t) \cos(m\omega_0 t) \cdot dt$$

$$s(t) = \frac{2}{T} \sum \cos(n\omega_0 t)$$
$$= \frac{2}{T} \sum \frac{e^{jn\omega_0 t} + e^{-jn\omega_0 t}}{2}$$

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





$\int s(t) \cdot dt = 0$

$\int \delta(t) \cdot dt$