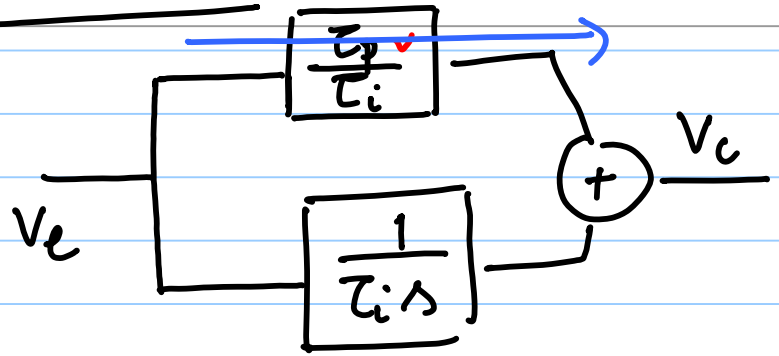
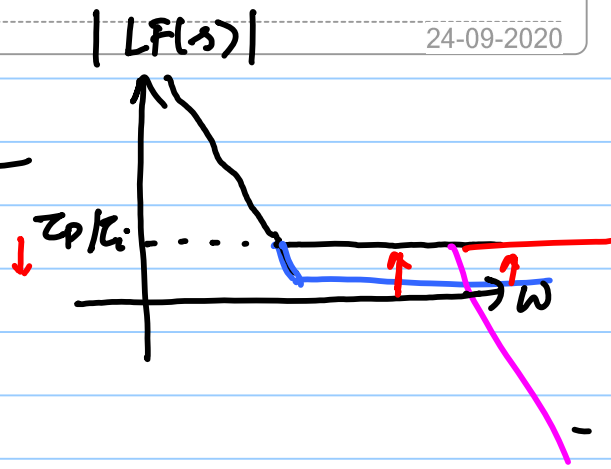
Note Title

Lecture #10

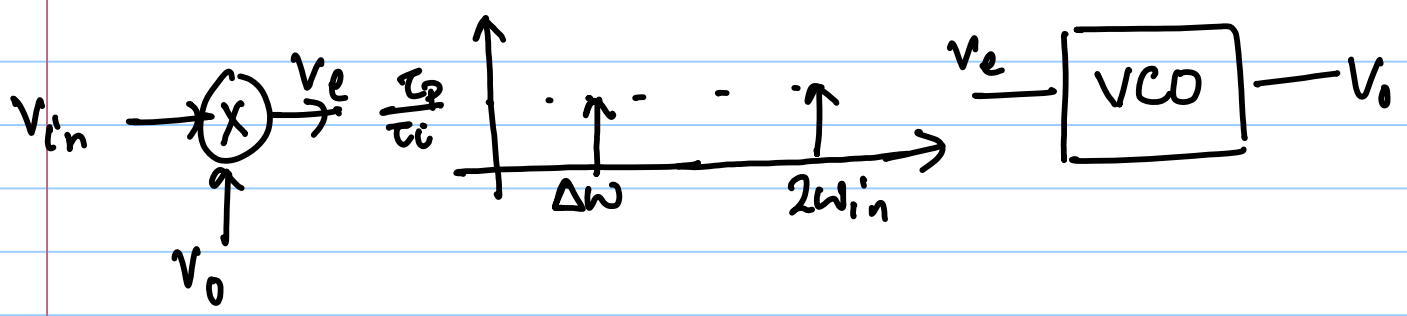
24-09-2020

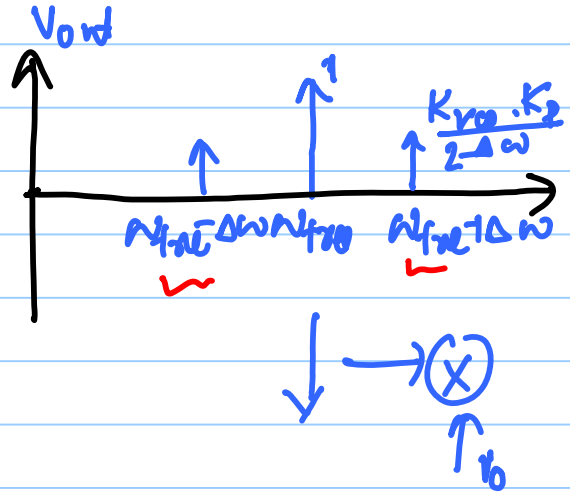


$$\frac{V_c}{V_e} = \frac{s\tau_p + 1}{s\tau_i}$$



$$V_e = \frac{1}{2}\left[\sin\left(\omega_{in} + \omega_{free}\, t + K_{VCO} \int V_c \, dt \right) + \sin\left(\Delta\omega(0) \cdot t - K_{VCO} \int V_c \, dt \right) \right]$$





$$V_0 = \sin\left(\omega_{free} t + \int K_{VCO} V_c \, dt \right)$$

$$= \sin\left(\omega_{free} t + \int K_{VCO} \cdot \frac{\tau_p}{\tau_i} \sin(\Delta\omega \cdot t) \, dt \right)$$

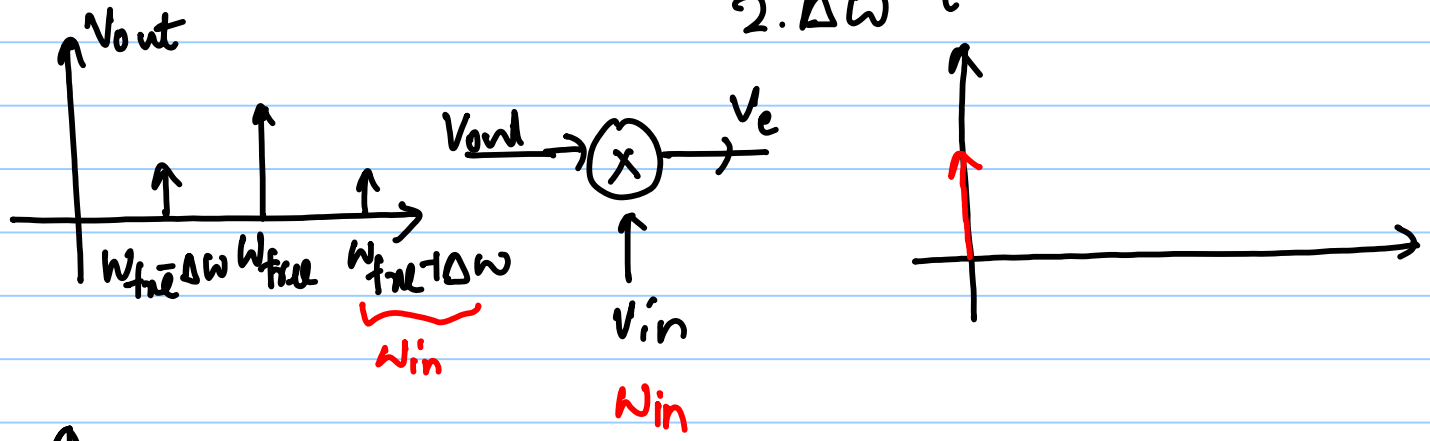
$$= \sin\left(\omega_{free} t - \frac{K_{VCO} K_P}{\Delta\omega} \cos(\Delta\omega \cdot t)\right)$$

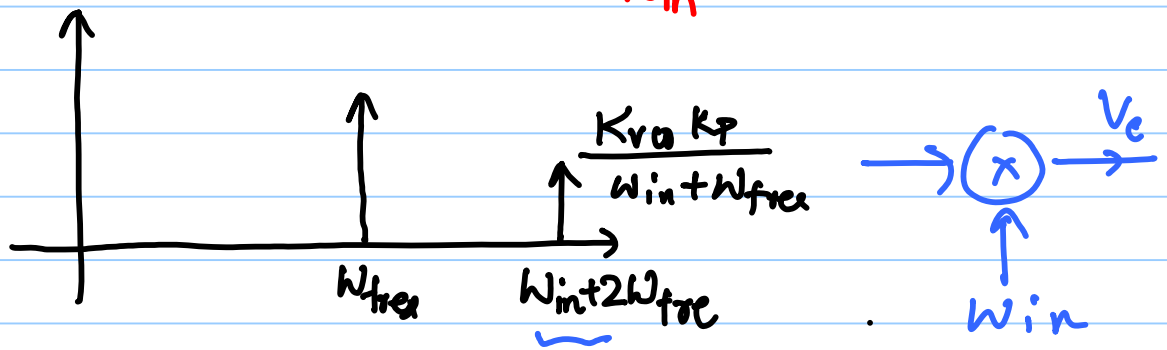
$$= \sin(\omega_{free} \cdot t) \cos\left(\frac{K_{VCO} \cdot K_P}{\Delta\omega} \cos(\Delta\omega \cdot t)\right) - \cos(\omega_{free} \cdot t) \sin\left(\underset{\approx 0}{1}\right)$$

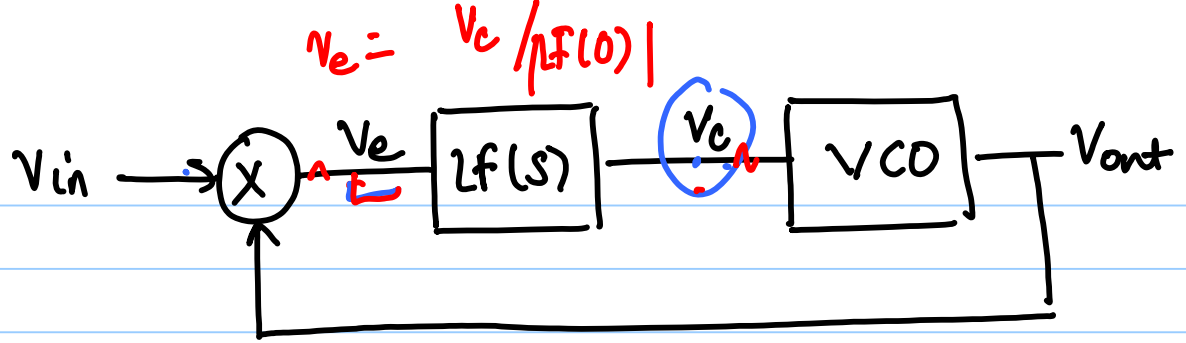
$\frac{K_{VCO} \cdot K_P}{\Delta\omega} \approx 0$

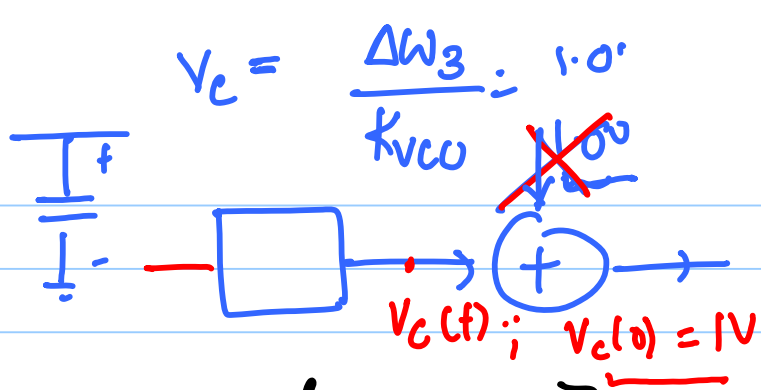
$$= \sin(\omega_{free} \cdot t) \cdot 1 - \cos(\omega_{free} \cdot t) \frac{K_{VCO} K_P}{\Delta\omega} \cos(\Delta\omega \cdot t)$$

$$= \sin(\omega_{free} \cdot t) - \frac{K_{VCO} K_P}{2 \cdot \Delta\omega} \left\{ \cos(\omega_{free} + \Delta\omega - t) + \cos(\omega_{free} - \Delta\omega t) \right\}$$









Lock-in range:

$$V_e = \frac{1}{2}\left[\sin(\quad) + \sin\left(\Delta\omega \cdot t - \int K_{VCO}\, V_c \cdot dt\right)\right]$$

ϕ_e

$$V_{in} = \sin(\omega_{in} t) = \sin\left(\omega_{in} \cdot (nT_s)\right)$$

$$V_{out} = \sin\left(\omega_{free} \cdot t + \int K_{VCO} \cdot V_c(t) \cdot dt\right)$$

$$= \sin\left(\omega_{free} \cdot (nT_s) + K_{VCO} \sum_{i=0}^{n} V_c(iT_s)\right)$$

$$\phi_{er}(nT_s) = \phi_{in}(nT_s) - \phi_{out}(nT_s)$$

$\omega_{in} = 1$ Grad/s.

$\Delta\omega_p = 2.5$ Grad/s.

$\omega_{free} = 3.5$ Grad/s.

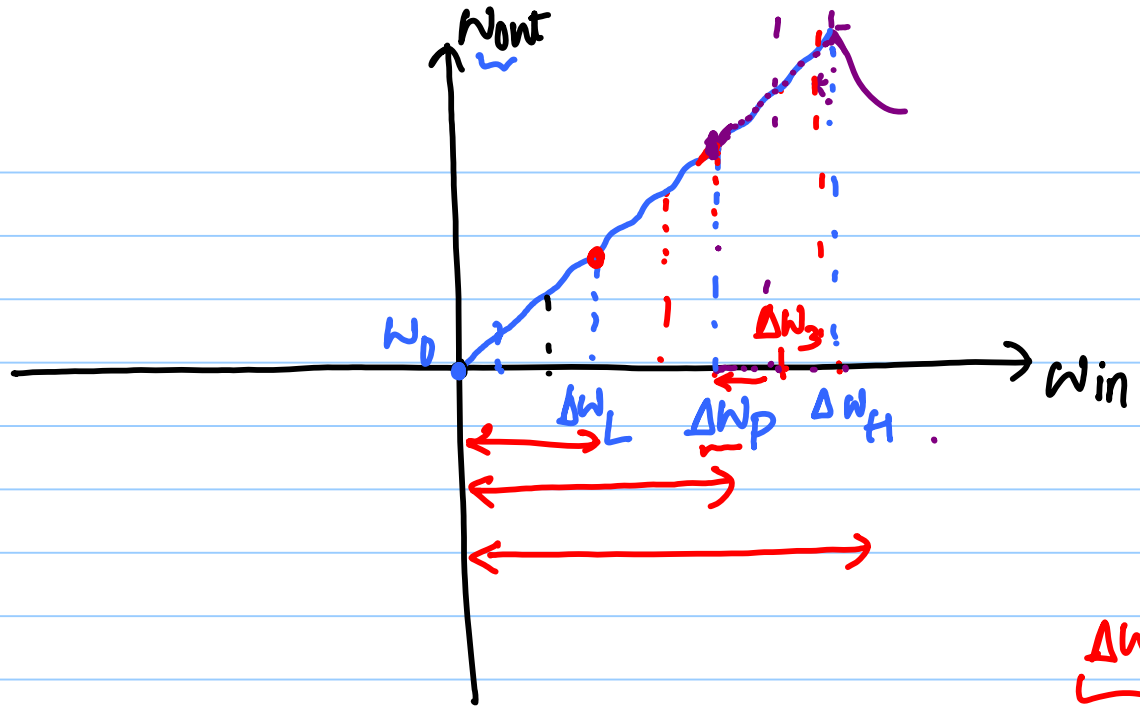
$\Delta\omega = -2.5$ Grad/s

$\omega_{out} \rightarrow 1$ Grad/s.

$\omega_{in} = 3.5$ Grad/s.

$\omega_{free} = 1$ Grad/s.

$\omega_{out} \rightarrow 3.5$ Grad/s



$\omega_{in} = \omega_{out} = \omega_0$ ✓

PLL

$\omega_{in} = \omega_0 + \Delta\omega_L \longrightarrow \omega_0 + \Delta\omega_L$

$\Phi_e \leq 2\pi$

$\omega_{in} = \omega_0 + \Delta\omega_2$

$\Delta\omega_L \leq \Delta\omega_2 \leq \Delta\omega_p$

$\omega_{in} = \omega_0 + \Delta\omega_3$

$\Delta\omega_p < \Delta\omega_3 \leq \Delta\omega_H$

$$\phi_{er} = \Delta w(0) \cdot t - K_{VCO} \int V_c \cdot dt \quad +$$

$$\phi_{er} = \Delta w(0) \cdot t - K_{VCO} \int K_{PD} \sin(\phi_{er})\, dt$$

$$\frac{d\phi_{er}}{dt} = \Delta w(0) - K_{VCO} K_{PD} \sin(\phi_{er}) = 0 \checkmark$$