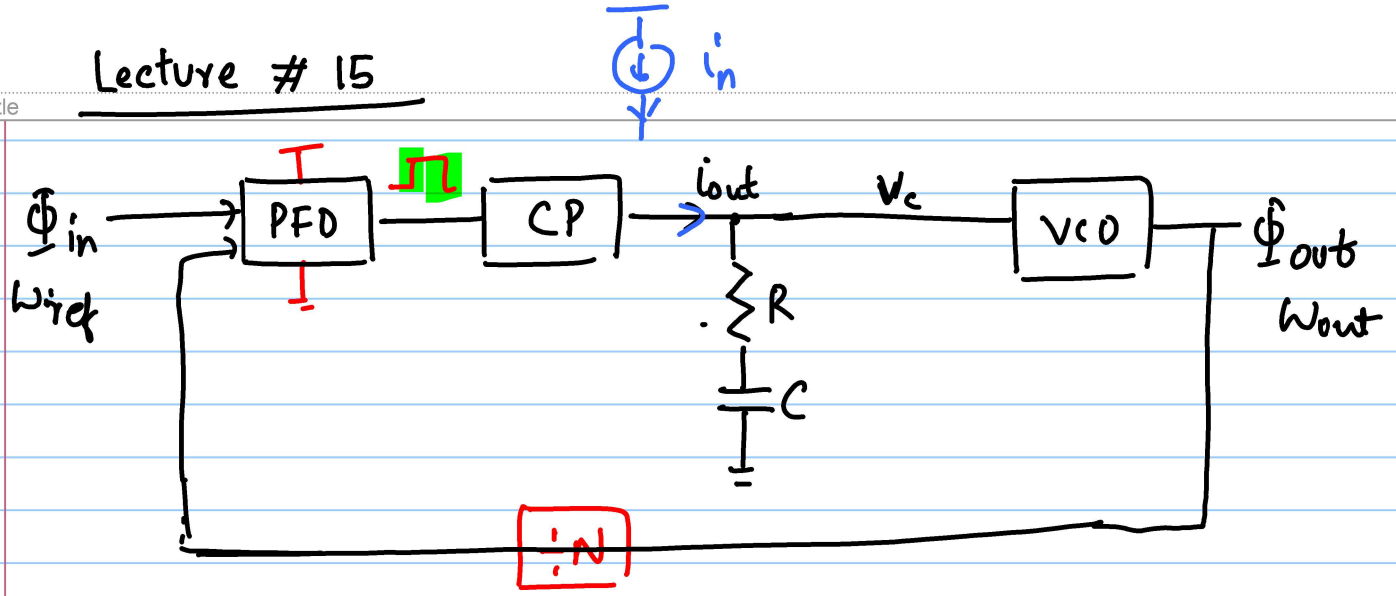
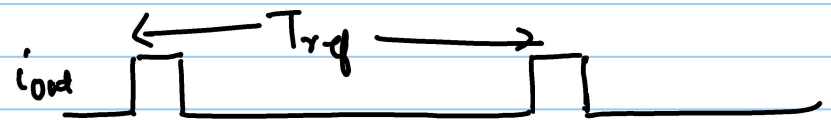
Lecture # 15

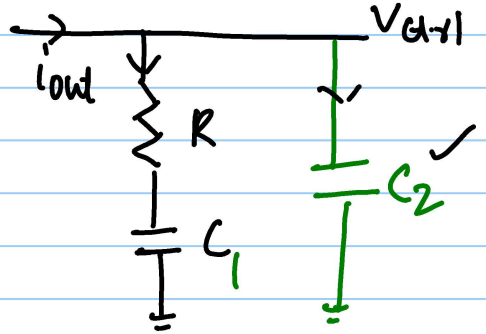
Note Title 03-09-2018



$$\omega_{out} = N\,\omega_{ref}.$$

$$(\omega_{out} \pm \omega_{fref})$$





$$Z_1 = \frac{1}{sC_2}$$

$$|Z_1|_{\omega=\omega_{ref}} = \frac{1}{(\omega_{ref} C_2)}$$

$$Z_2 = R + \frac{1}{sC_1} \quad ; \quad |Z_2| = \left| R + \frac{1}{j\omega C_1} \right| = \sqrt{R^2 + \frac{1}{\omega_{ref}^2 C_1^2}}$$

$$\frac{V_c|_{C_2}}{V_c|_R} = \frac{i_{out}/\omega_{rg} C_2}{i_{out} \cdot R} \ll 1 \Rightarrow \frac{1}{\omega_{rg} C_2 R} \ll 1$$

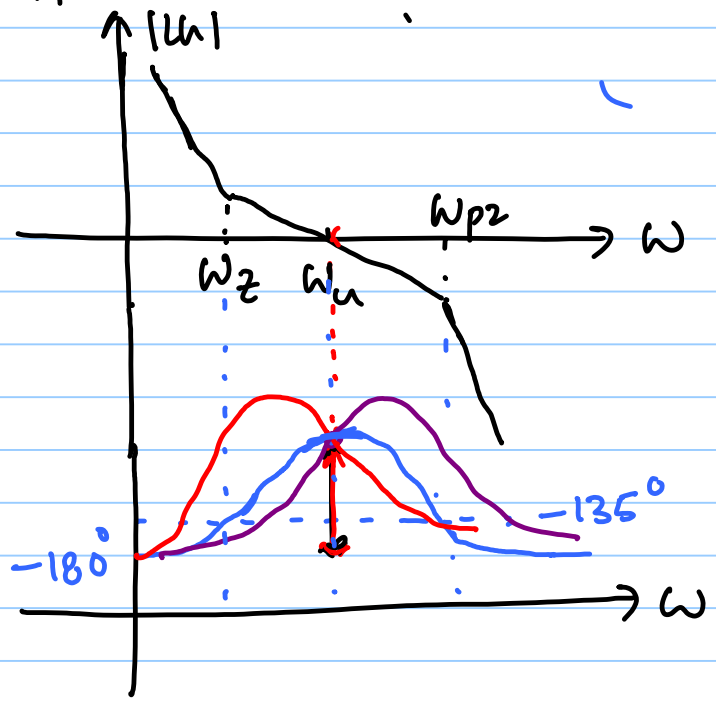
$$LF(s) = \left(R + \frac{1}{sC_1}\right) \| \frac{1}{sC_2} = \frac{\frac{1+sC_1R}{sC_1} \times \frac{1}{sC_2}}{\frac{1+sC_1R}{sC_1} + \frac{1}{sC_2}} = \frac{1+sC_1R}{sC_2 + s^2 C_1 C_2 R + sC_1}$$

$$= \frac{1+sC_1R}{s(C_1+C_2)\left[1 + s\frac{C_1C_2}{C_1+C_2}R\right]}$$

$$\omega_z = \frac{1}{C_1 R}, \quad \omega_{p1} = 0, \quad \omega_{p2} = \frac{1}{\frac{C_1C_2}{C_1+C_2}R}$$

$$LG(s) = \frac{1}{2\pi} I_{cp} \, LF(s) \times \frac{2\pi K_{VCO}}{s} \times \frac{1}{N} = \frac{I_{cp}}{s^2(C_1+C_2)} \frac{K_{VCO}}{N} \frac{(1+s/\omega_z)}{(1+s/\omega_{p2})}$$

Type-II, Order-3

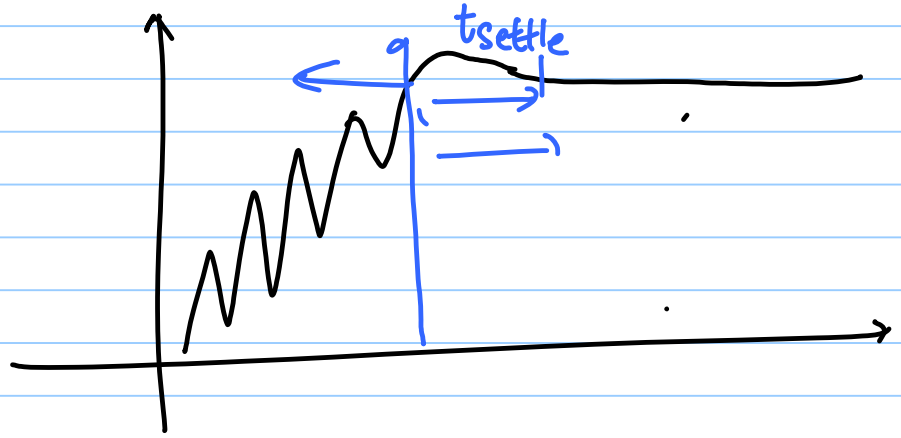


$$\angle L(s) = -180^\circ + \tan^{-1}\left(\frac{\omega_u}{\omega_z}\right) - \tan^{-1}\left(\frac{\omega_u}{\omega_{pz}}\right)$$

$$|L(j\omega_u)| \approx \frac{I_{cp}}{\omega_u^2 (C_1+C_2)} \frac{K_{vco}}{N} \frac{\omega_u/\omega_z}{\omega_u/\omega_{pz}} = 1$$

$$\phi_m = -180^\circ - \angle L(s)$$

$$= \tan^{-1}\left(\frac{\omega_u}{\omega_{pz}}\right) - \tan^{-1}\left(\frac{\omega_u}{\omega_z}\right)$$



✓ ω_{BW} (MHz): Settling time., noise ↓

1 MHz

Φ_m :

Kvco