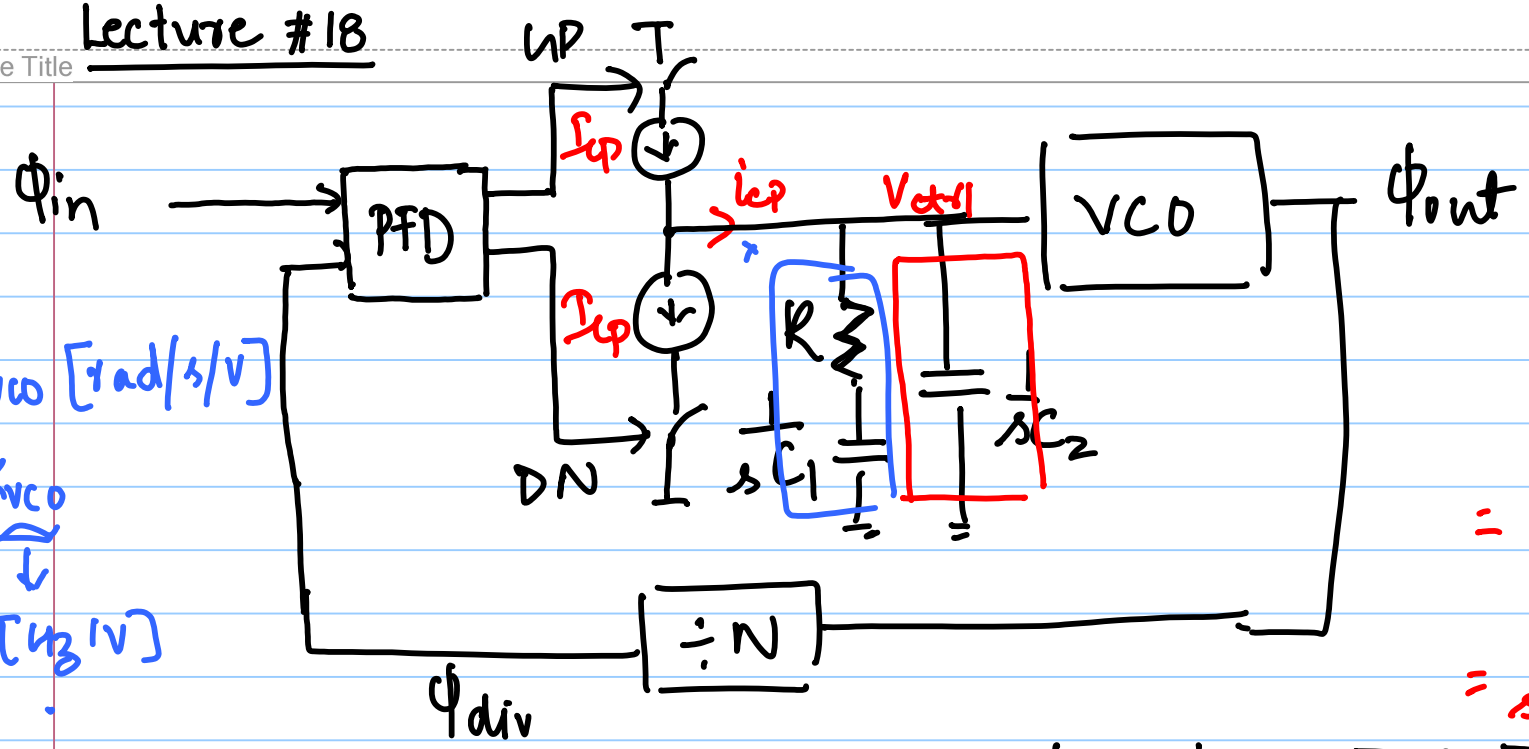
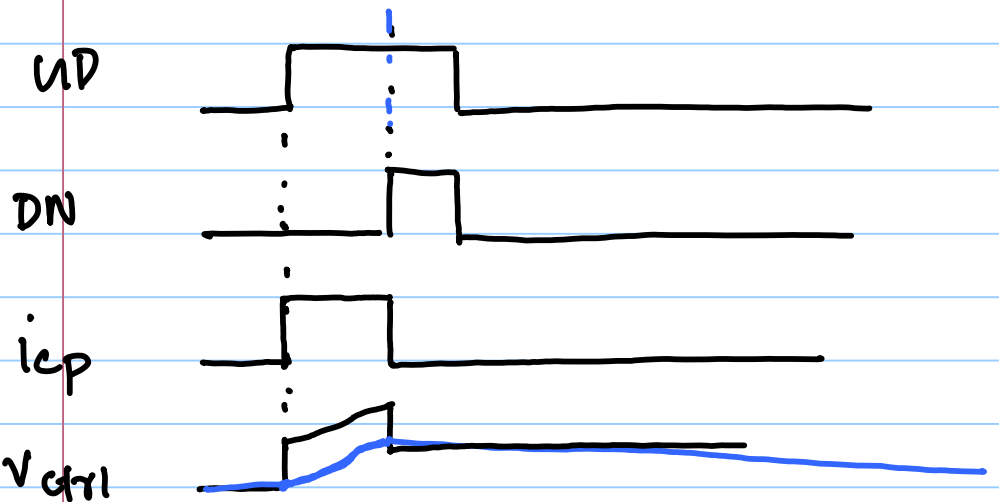
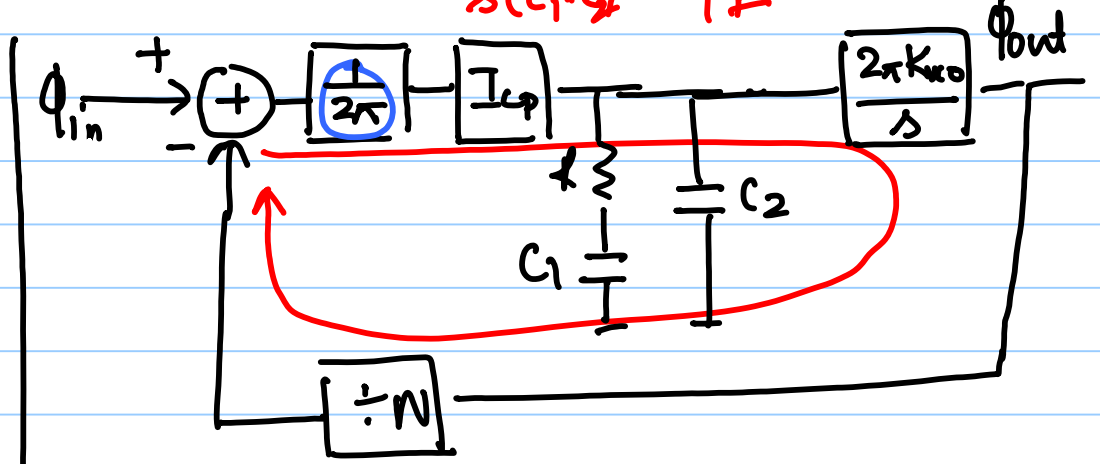
Lecture #18

Note Title 13-10-2020





$$\frac{\left(R+\frac{1}{sC_1}\right)\frac{1}{sC_2}}{R+\frac{1}{sC_1}+\frac{1}{sC_2}} = \frac{(1+sRC_1)/s^2C_1C_2}{\frac{sC_1C_2R+C_1+C_2}{sC_1C_2}} = \frac{1}{s(C_1+C_2)} \times \frac{(1+sRC_1)}{1+}$$



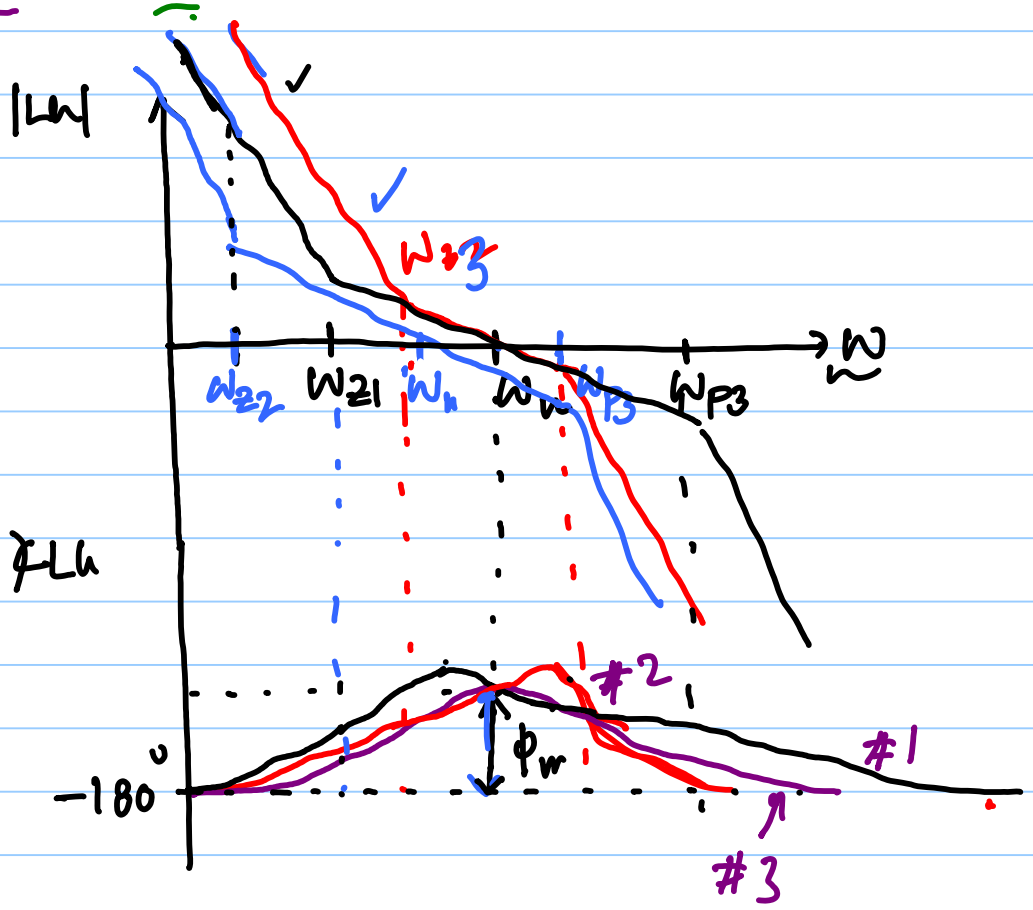
$$LG = \frac{1}{2\pi} I_{cp} \times \frac{1+sRC_1}{1+sRC_1C_2/C_1+C_2} \times \frac{1}{s(C_1+C_2)} \times \frac{2\pi K_{VCO}}{sN}$$

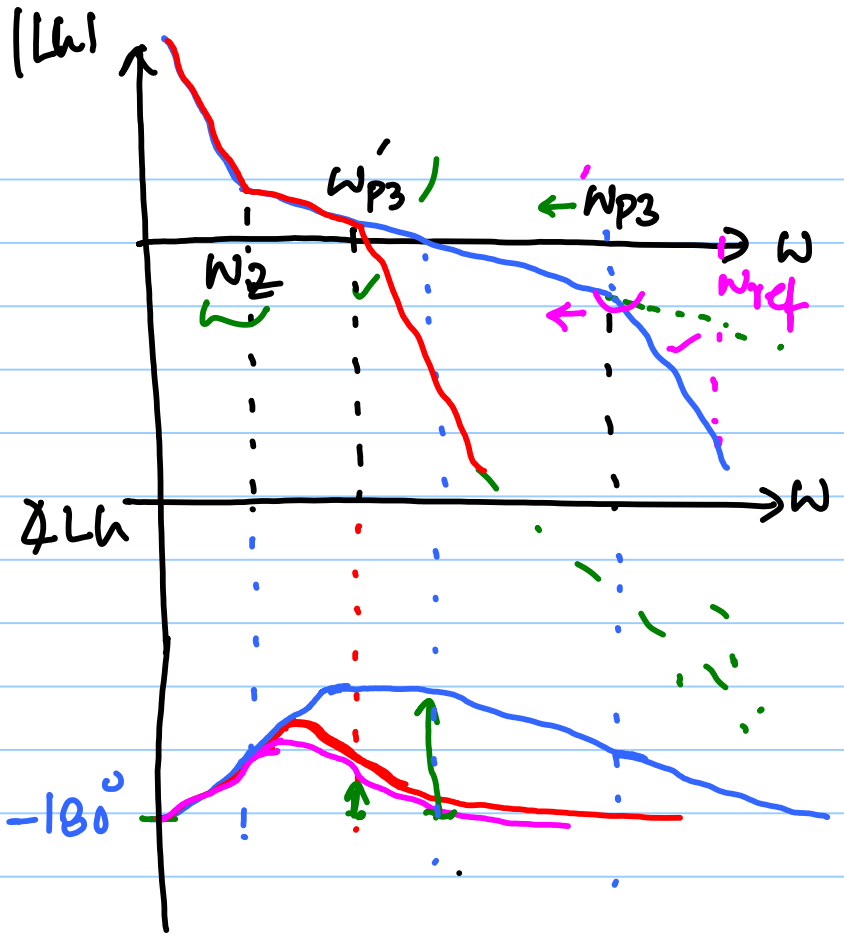
$$= \frac{I_{cp} K_{VCO}}{s^2(C_1+C_2)N} \cdot \frac{1+sRC_1}{1+sRC_1C_2/C_1+C_2}$$

$$\omega_{p1} = \omega_{p2} = 0 \;, \quad \omega_{p3} = \frac{1}{\frac{RC_1C_2}{C_1+C_2}}$$

$$\omega_z = \frac{1}{RC_1}$$

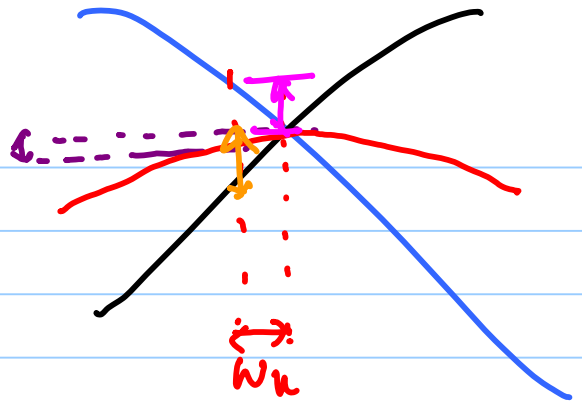
ω_u, ϕ_M : $\omega_z, \omega_{p3} \Rightarrow R, C_1, C_2$





$$\angle L(j\omega) = -180^\circ + \tan^{-1}\left(\frac{\omega}{\omega_z}\right) - \tan^{-1}\left(\frac{\omega}{\omega_{p3}}\right)$$

$$|L(j\omega)| = \frac{I_{cp} K_{VCO}}{(C_1+C_2) N \omega^2} \left|\frac{1+j\omega/\omega_z}{1+j\omega/\omega_{p3}}\right|$$



$\phi_m = \angle L(j\omega_u) - (-180^\circ) = \tan^{-1}\left(\frac{\omega_u}{\omega_z}\right) - \tan^{-1}\left(\frac{\omega_u}{\omega_{p3}}\right)$

✓ $\angle L(j\omega) = -180^\circ + \tan^{-1}\left(\frac{\omega}{\omega_z}\right) - \tan^{-1}\left(\frac{\omega}{\omega_{p3}}\right)$

$$\left.\frac{d\angle L(j\omega)}{d\omega}\right|_{\omega=\omega_u} = \frac{1}{1+\left(\frac{\omega_u}{\omega_z}\right)^2}\times\frac{1}{\omega_z} - \frac{1}{1+\left(\frac{\omega_u}{\omega_{p3}}\right)^2}\frac{1}{\omega_{p3}}$$

$$= \frac{\omega_z}{\omega_z^2+\omega_u^2} - \frac{\omega_{p3}}{\omega_{p3}^2+\omega_u^2} = 0$$

$$\Rightarrow \quad \omega_z\omega_u^2 - \omega_u^2\omega_{p3} + \omega_z\omega_{p3}^2 - \omega_{p3}\omega_z^2 = 0$$

$$\omega_u^2(\omega_z-\omega_{p3}) - \omega_z\omega_{p3}(\omega_z-\omega_{p3}) = 0$$

$$(\omega_u^2 - \omega_z\omega_{p3})(\omega_z-\omega_{p3}) = 0$$

$$\Rightarrow \boxed{\omega_u^2 = \omega_z\omega_{p3}} \checkmark \Rightarrow \omega_u^2 = \frac{1}{RC_1}\frac{1}{\frac{RC_1C_2}{C_1+C_2}} = \left(\frac{1}{RC_1}\right)^2\frac{C_1+C_2}{C_2}$$

$$\omega_{u2}^2 \quad \omega_2^2 \quad \frac{C_1+C_2}{C_2}$$

$$\phi_m = \tan^{-1}\left(\frac{\omega_u}{\omega_z}\right) - \tan^{-1}\left(\frac{\omega_u}{\omega_{p3}}\right)$$

$$\phi_m = \tan^{-1}\left(\sqrt{1+\frac{C_1}{C_2}}\right) - \tan^{-1}\left(\frac{1}{\sqrt{1+\frac{C_1}{C_2}}}\right) \qquad \omega_n = \omega_z \sqrt{1+\frac{C_1}{C_2}}$$

$$C_1 = 2C_2\left(\tan^2\phi_m + \tan\phi_m\sqrt{1+\tan^2\phi_m}\right)$$