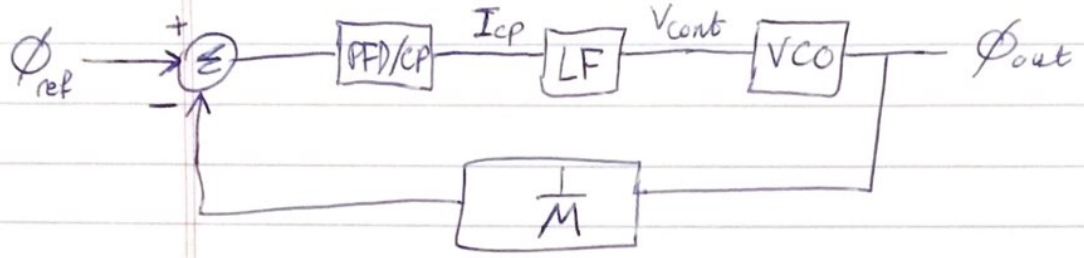

$$LG = H_{open} \times \frac{1}{M}$$

$$= \frac{1}{M} \times \left(\frac{I_{cp}}{2\pi}\right) \times \left(\frac{1}{C_1 C_2 R_1} \frac{1 + sC_1R_1}{s^2 + \left(\frac{C_1+C_2}{C_1C_2R_1}\right)s}\right) \times \frac{K_{VCO}}{s}$$

$$= \underbrace{\frac{I_{cp} K_{VCO}}{2\pi M C_1 C_2 R_1}}_{\text{Const 1}} \frac{1}{s^2} \frac{1 + sC_1R_1}{s + \left[\frac{C_1+C_2}{C_1C_2R_1}\right]}$$

$$\text{open loop Gain} = \frac{\text{Const1} + s\,C_1R_1\,\text{Const1}}{s^3 + \left[\frac{C_1+C_2}{C_1C_2R_1}\right]s^2}$$

→ Get PM from this TF

$$H_{closed} = \frac{H_{open}}{1 + (H_{open} \times \frac{1}{M})}$$

$$= \frac{M\left(\frac{\text{Const1} + s\,C_1R_1\,\text{Const1}}{s^3 + \left[\frac{C_1+C_2}{C_1C_2R_1}\right]s^2}\right)}{1 + \frac{\text{Const1} + s\,C_1R_1\,\text{Const1}}{s^3 + \left[\frac{C_1+C_2}{C_1C_2R_1}\right]s^2}}$$

$$\text{closed loop Gain} = \frac{M\,\text{Const1} + s\,C_1R_1M\,\text{Const1}}{s^3 + \left[\frac{C_1+C_2}{C_1C_2R_1}\right]s^2 + s\,C_1R_1\,\text{Const1} + \text{Const1}}$$

↳ Get BW from this TF

$$LF = \left(R_1 + \frac{1}{sC_1}\right) // \left(\frac{1}{sC_2}\right)$$

$$= \frac{\frac{sC_1R_1+1}{sC_1}\frac{1}{sC_2}}{\frac{sC_1R_1+1}{sC_1} + \frac{1}{sC_2}}$$

$$= \frac{1 + sC_1R_1}{s^2C_1C_2R_1 + sC_2 + sC_1}$$