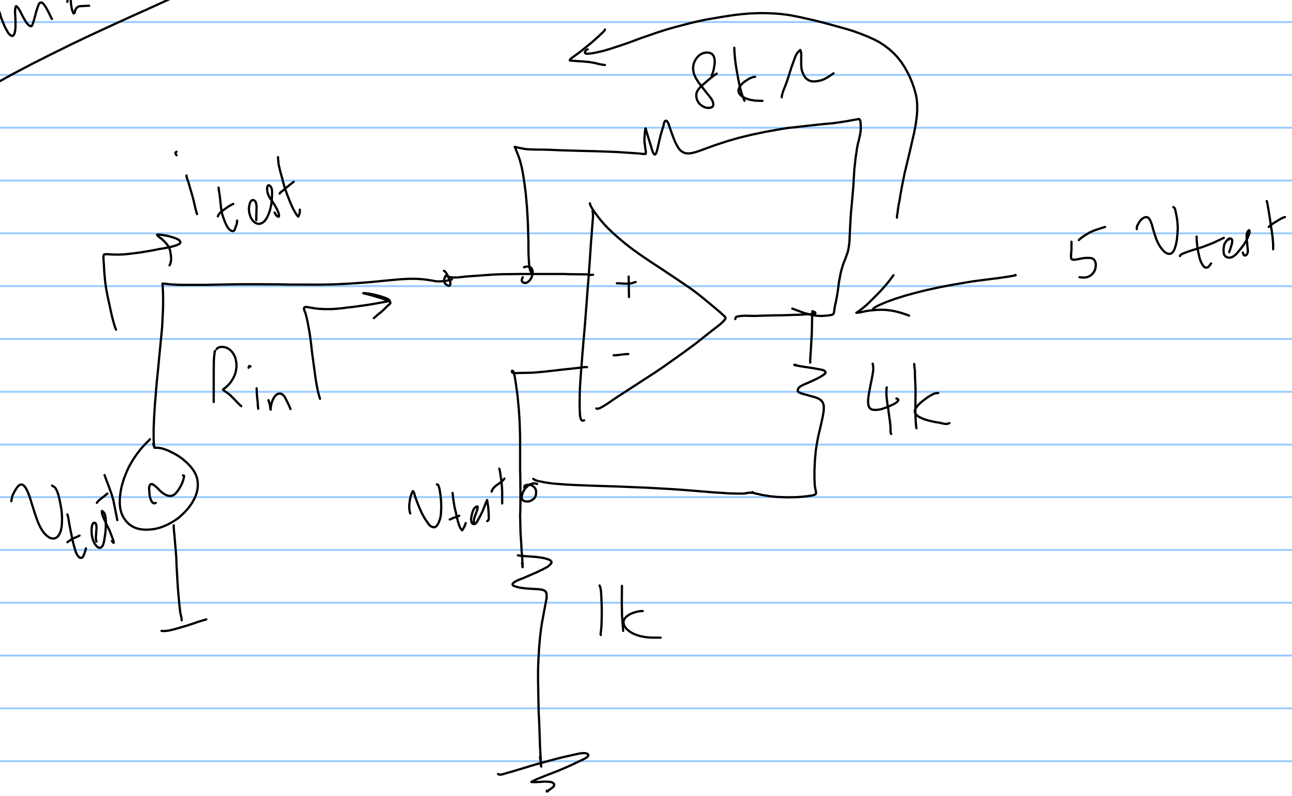
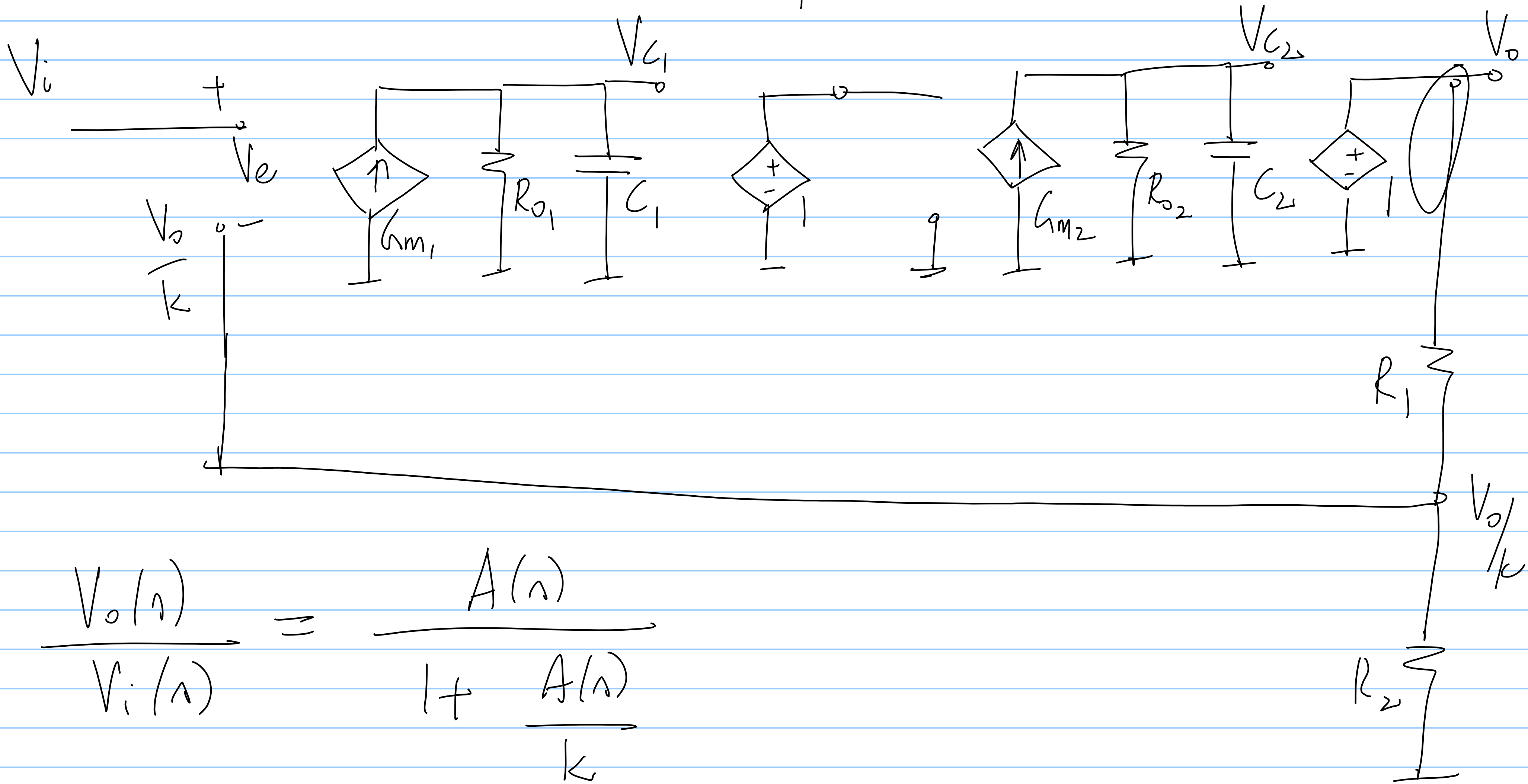
15/2/19

Lec 16

Quiz 1



2-stage opamp



$$\frac{V_o(s)}{V_i(s)} = \frac{A(s)}{1 + \frac{A(s)}{k}}$$

$$A(s) = A_1(s) \cdot A_2(s) \quad ; \quad A_0 = A_{01} \cdot A_{02}$$

$$= \frac{A_{01}}{(1 + s/p_1)} \cdot \frac{A_{02}}{(1 + s/p_2)}$$

$$\frac{V_o(s)}{V_i(s)} = \frac{k}{1 + \frac{k}{A(s)}} = \frac{k}{1 + \frac{k}{A_0} \cdot \left(1 + \frac{s}{p_1}\right)\left(1 + \frac{s}{p_2}\right)}$$

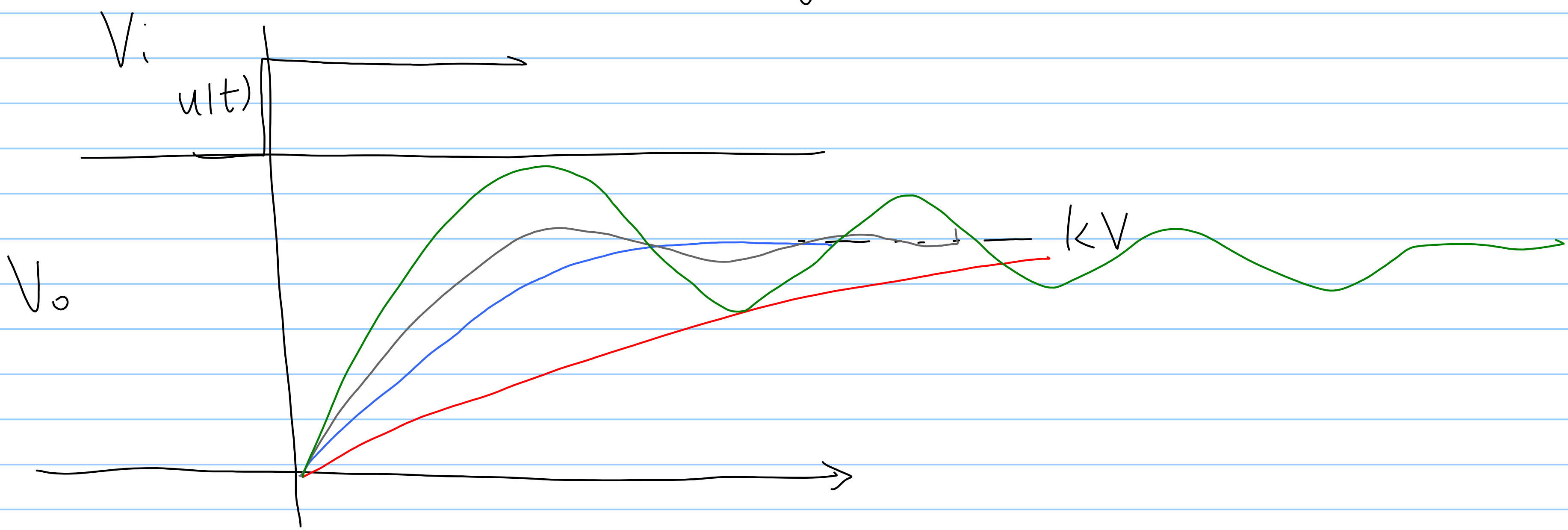
$$= \frac{k}{\left(1 + \frac{k}{A_0}\right) + \frac{sk}{A_0}\left(\frac{1}{p_1} + \frac{1}{p_2}\right) + s^2 \frac{1}{p_1} \cdot \frac{1}{p_2} \cdot \frac{k}{A_0}}$$

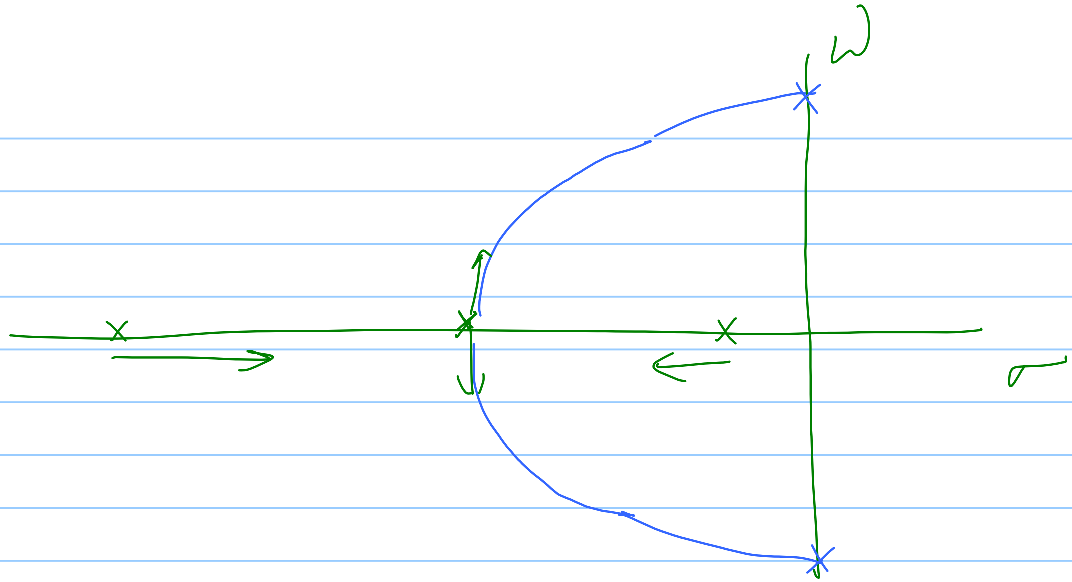
all coefficients +ve $\Rightarrow$ Roots in LHP

$$s^2 + 2\zeta\omega_n s + \omega_n^2$$

$$s^2 + \frac{\omega_n s}{Q} + \omega_n^2$$

} Std. forms of 2nd order system

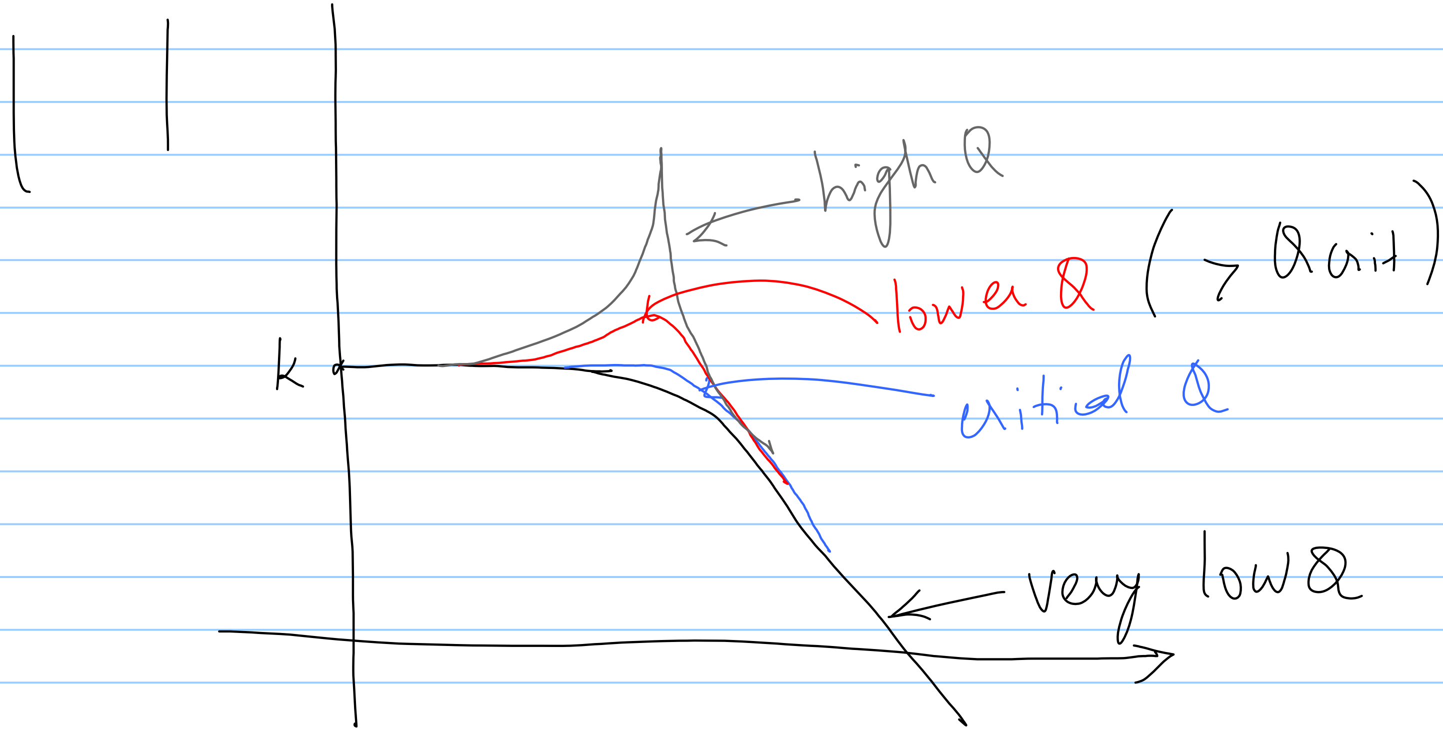




$$\omega_n = \sqrt{\left(\frac{A_0}{K} + 1\right)(p_1 p_2)}$$

$$\zeta = \frac{1}{2}\left[\sqrt{\frac{p_1}{p_2}} + \sqrt{\frac{p_2}{p_1}}\right]\sqrt{\frac{K}{A_0 + K}}$$

$$Q = \frac{1}{2\zeta} = \sqrt{\frac{A_0 + k}{k}} \cdot \frac{1}{\sqrt{\frac{p_1}{p_2}} + \sqrt{\frac{p_2}{p_1}}}$$



* unconditionally stable
* ringing possible
* well-spaced apart poles. avoids ringing

Next step - 3 stage opamp

$$A(s) = \frac{A_0}{(1 + s/p)^3}$$

} even more tending towards ringing