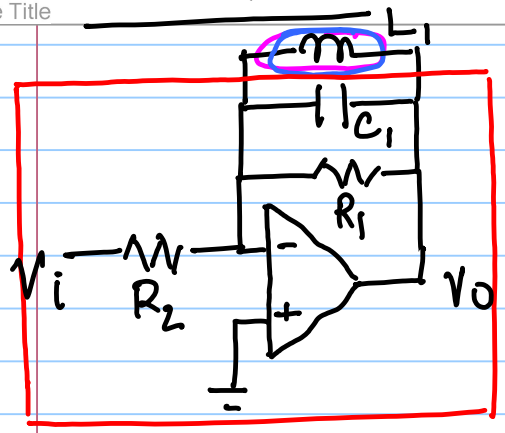
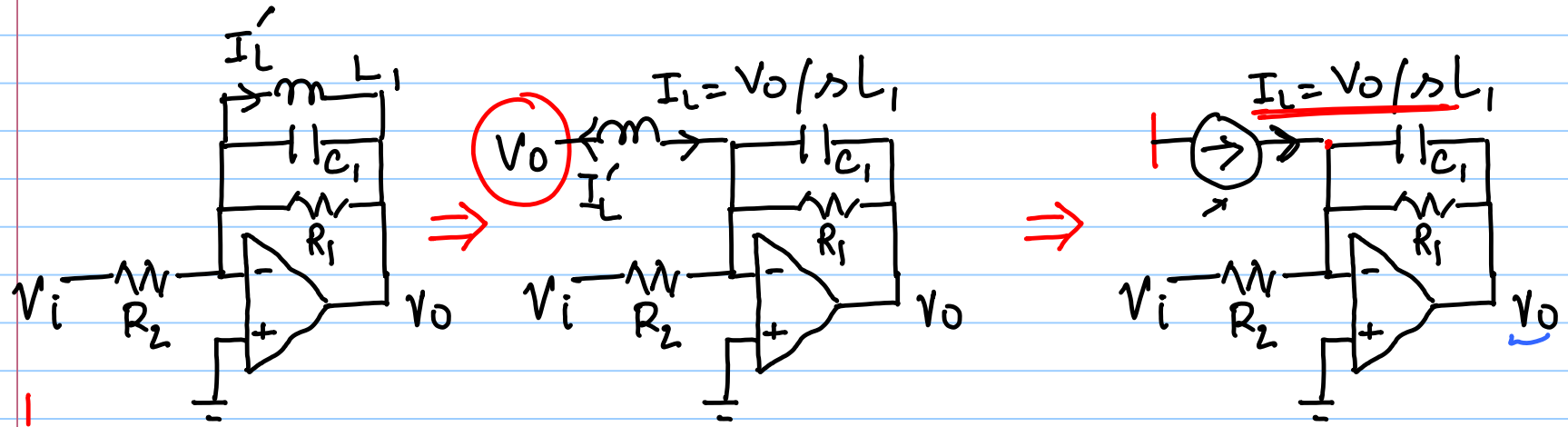
Lecture # 37

Note Title



$$\frac{V_o}{V_i} = -\frac{R_1}{R_2}\,\frac{sL_1/R_1}{s^2L_1C_1 + s\frac{L_1}{R_1} + 1} = -\frac{R_1}{R_2}\,\frac{s/\omega_0 Q}{\left(\frac{s}{\omega_0}\right)^2 + \frac{s}{\omega_0 Q} + 1}$$



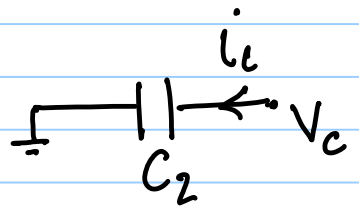
$$I_L' = -\frac{V_o}{sL_1}$$

Need a current source $\boxed{I_L = \frac{V_0}{sL_4}}$

$i_L \propto K \int V_0 \, dt$

$i = C \frac{dV}{dt}$

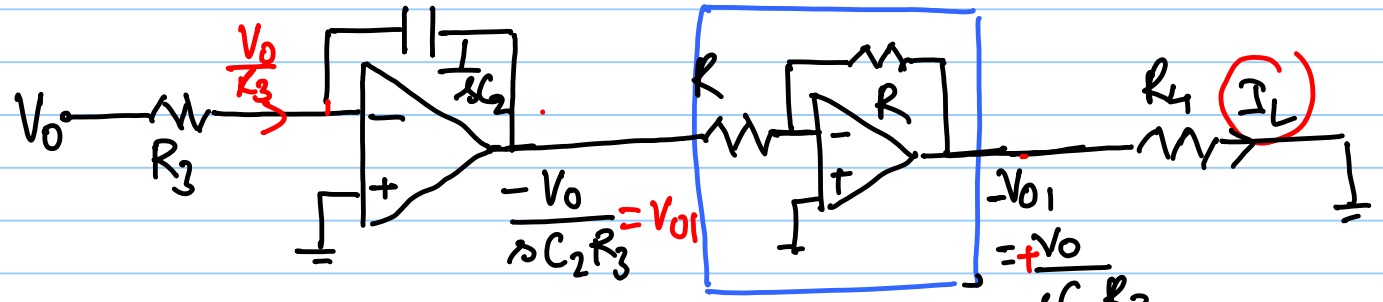
$V = \frac{1}{C} \int i \, dt$



$V_C = \frac{I_C}{sC} = \frac{(V_0/R)}{sC}$

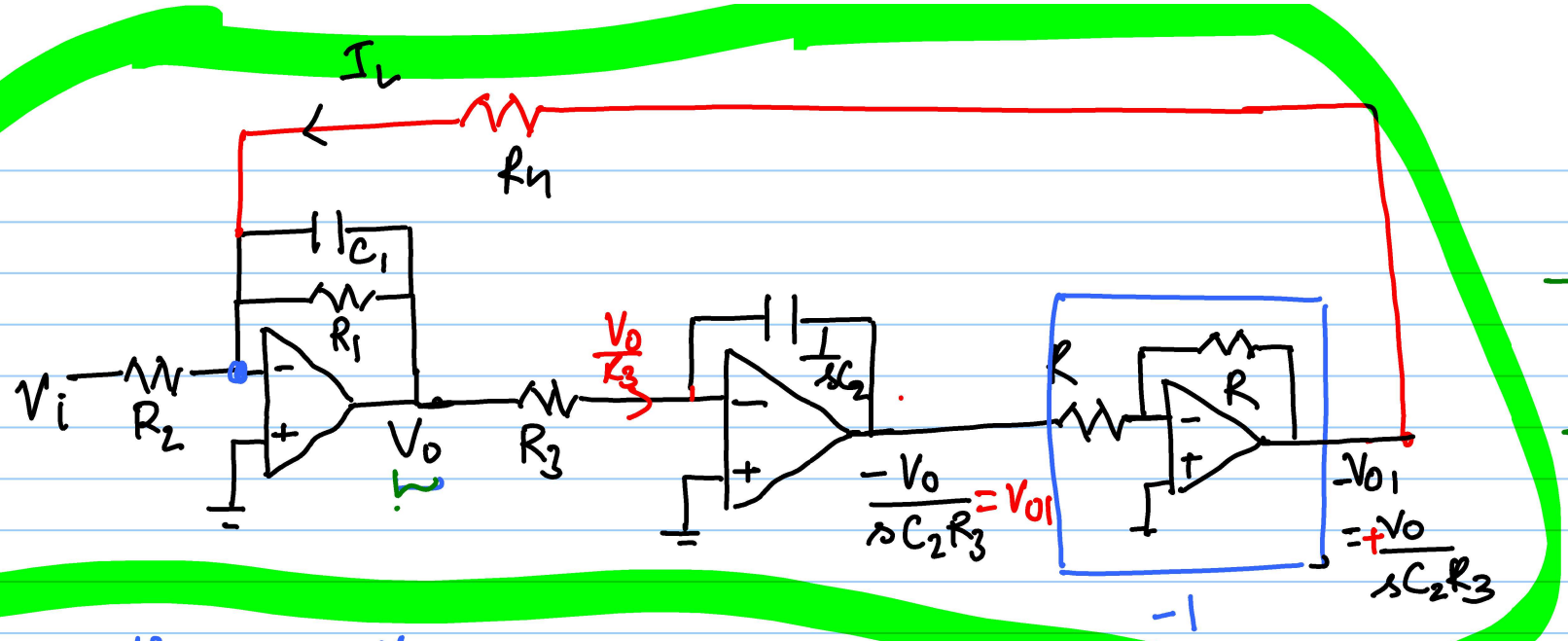
$= \frac{1}{R_3} \frac{V_0}{sC}$

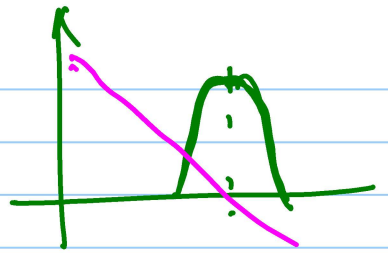
$\frac{I}{L} = \frac{V_C}{R_4} = \frac{V_0/sCR_3}{R_4} = \frac{V_0}{sCR_3R_4} = \boxed{\frac{V_0}{sCR^2} = I}$



$I_L = \frac{V_0}{sC_2R_3R_4}$

$= \frac{V_0}{sL}$





$$\frac{V_{01}}{V_0} = \frac{-1}{sC_2R_3}$$

$$\frac{V_i}{R_2} + \frac{V_0}{sC_2R_3R_4} = -\frac{V_0}{R_1} - V_0 sC_1$$

$$\frac{V_i}{R_2} = -V_0\left(\frac{1}{R_1} + sC_1 + \frac{1}{sC_2R_3R_4}\right) = V_0\left(\frac{1}{R_1} + sC_1 + \frac{1}{sL_1}\right)$$

$$\frac{V_i}{R_2} = \frac{-V_0}{sL_1R_1}\left(sL_1 + s^2L_1C_1R_1 + R_1\right) \Rightarrow \frac{V_0}{V_i} = -\frac{1}{R_2}\,\frac{sL_1R_1}{s^2L_1C_1R_1 + sL_1 + R_1}$$

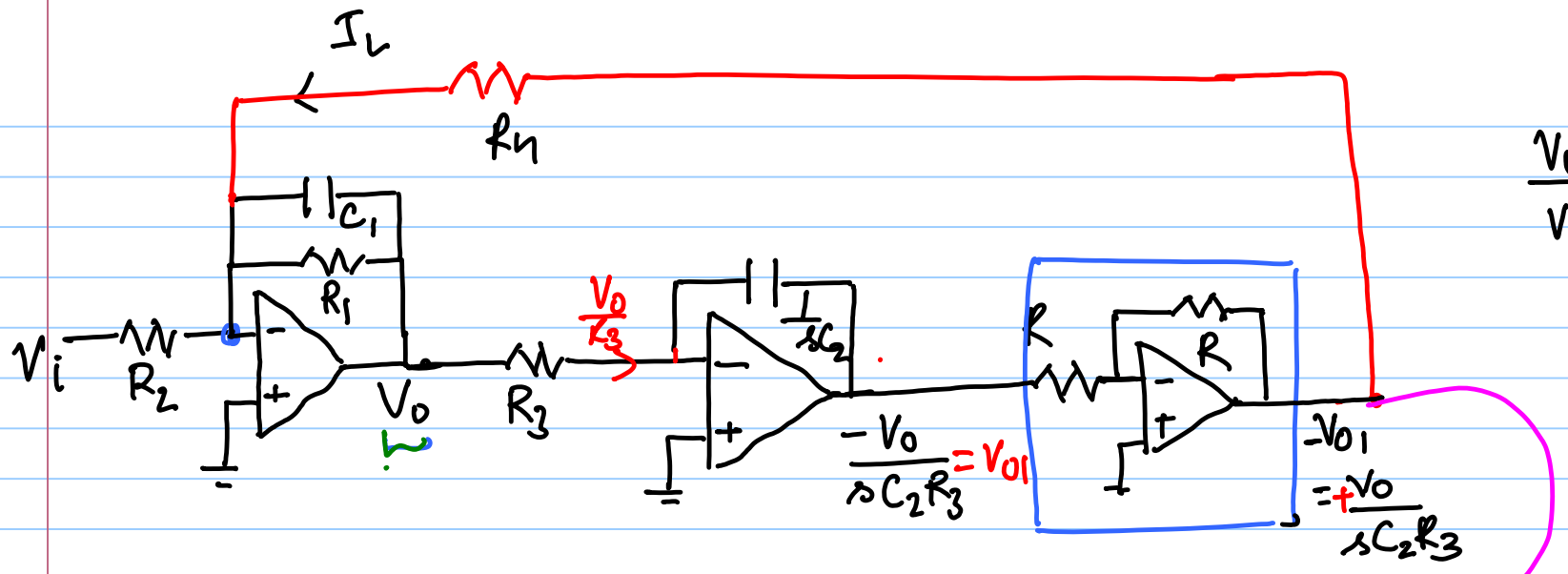
$$\frac{V_o}{V_i} = -\frac{R_1}{R_2} \cdot \frac{sL_1/R_1}{s^2L_1C_1 + s\frac{L_1}{R_1} + 1} \qquad \text{(BPF)}$$

$$\frac{V_{o1}}{V_i} = \frac{V_o}{V_i} \cdot \frac{V_{o1}}{V_o}$$

$$= -\frac{R_1}{R_2} \cdot \frac{s(R_3R_4C_2)/R_1}{s^2C_1C_2R_3R_4 + s\frac{C_2R_3R_4}{R_1} + 1} \times \frac{-1}{sR_3C_2}$$

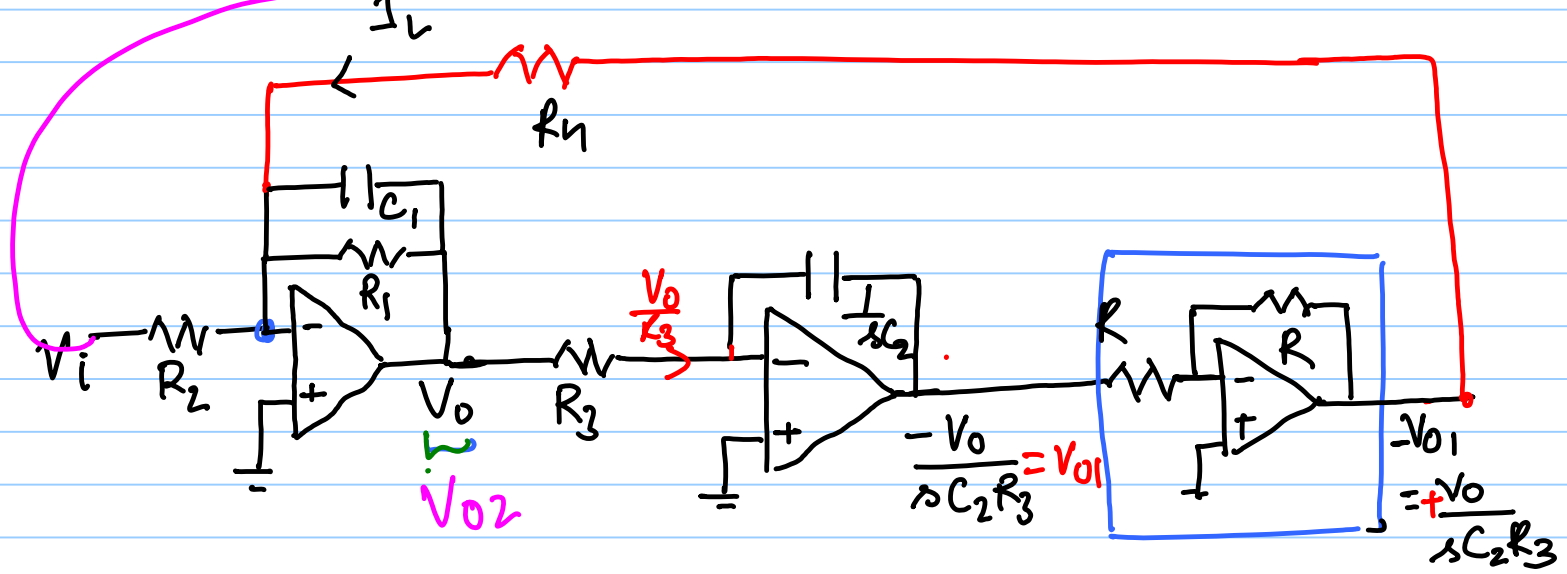
$$= +\frac{R_1}{R_2} \cdot \frac{R_4/R_1}{s^2(C_1C_2R_3R_4) + s\frac{C_2R_3R_4}{R_1} + 1} = \frac{R_4/R_2}{s^2L_1C_1 + s\frac{L_1}{K} + 1}$$

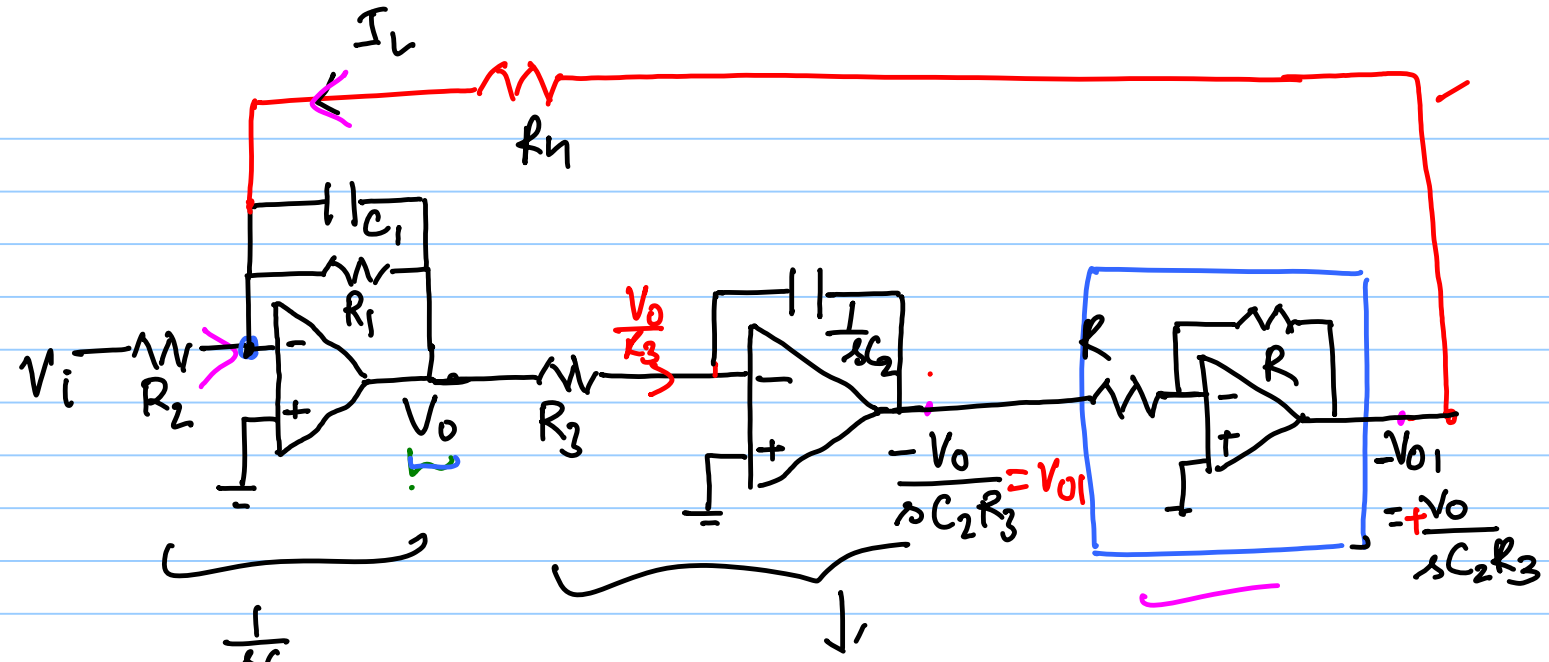
2nd Order low-pass tf.



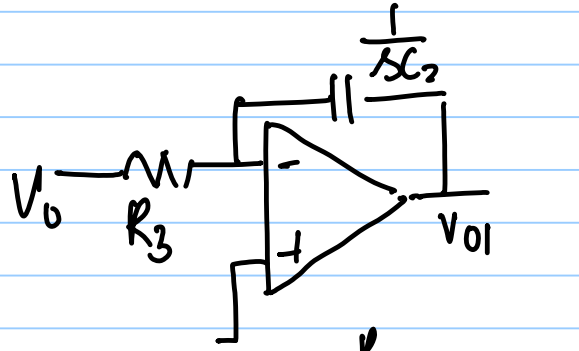
$$\frac{V_o}{V_i} = \frac{-R_1}{R_2} \cdot \frac{sL_1/R_1}{s^2L_1C_1 + \frac{sL_1}{R_1} + 1}$$

$$L_1 = R_3R_4C_2$$

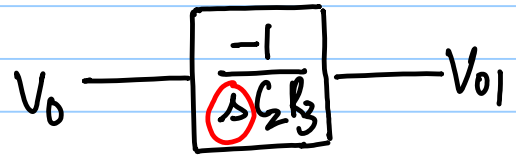


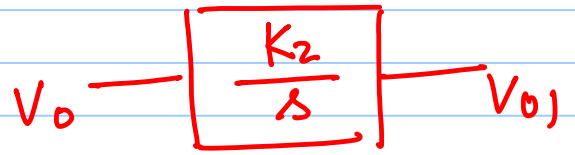


- Integration of current.
- Gain block.
- Summing currents.

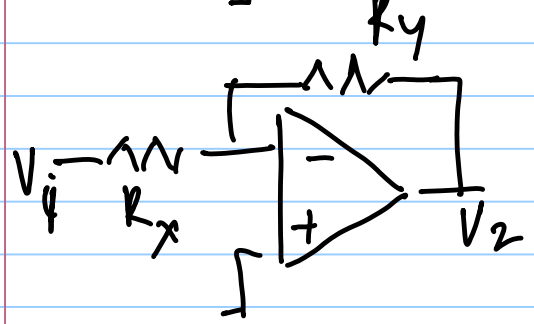


$\equiv$

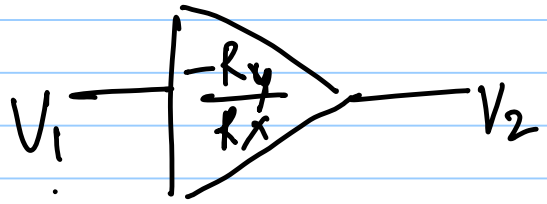


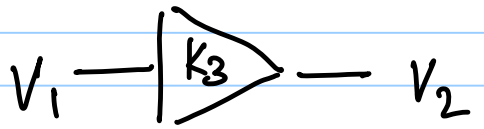


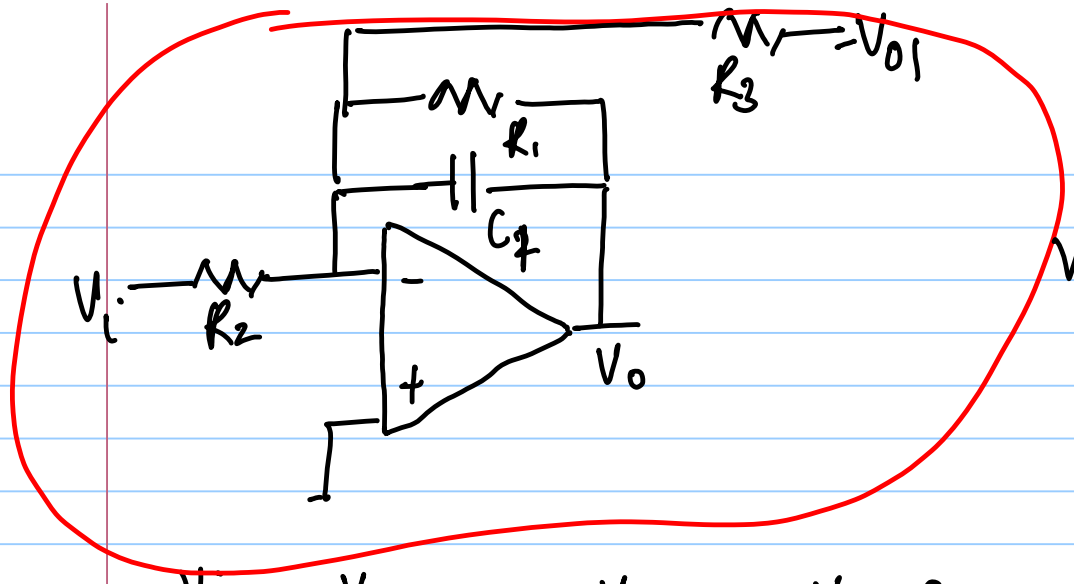
$K_2 = -1/R_3C_2$

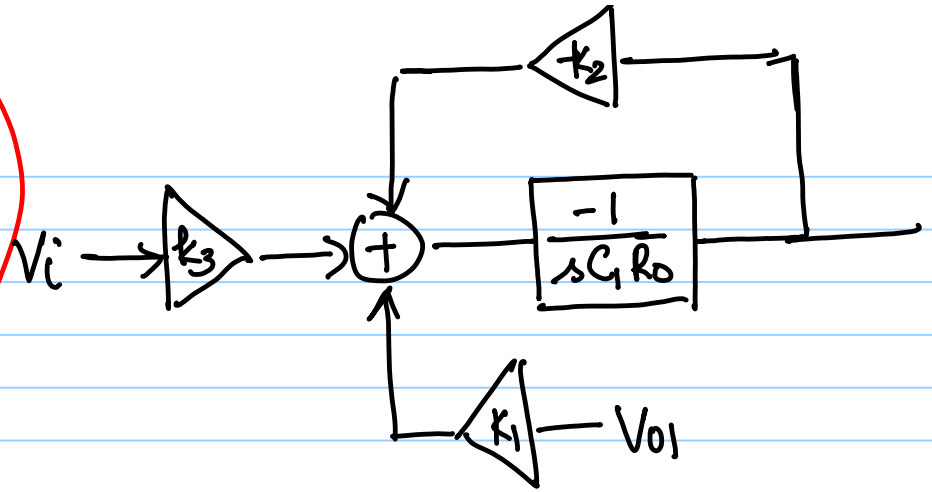


$\equiv$









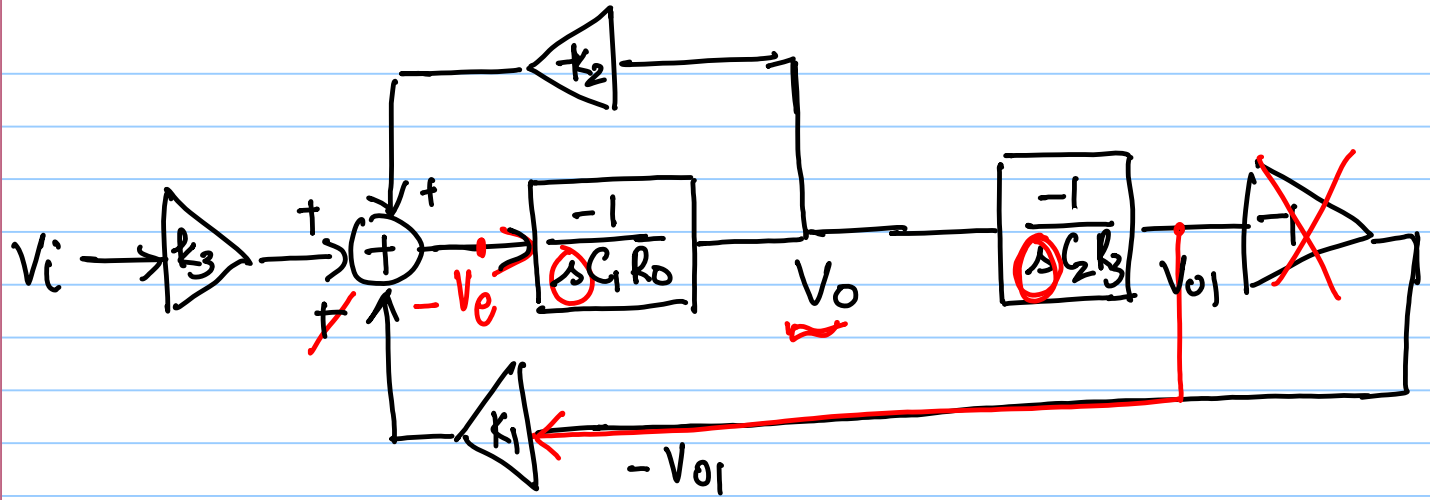
$$\frac{V_i}{R_2} - \frac{V_{01}}{R_3} = -\frac{V_o}{R_1} - V_o\, sC_1$$

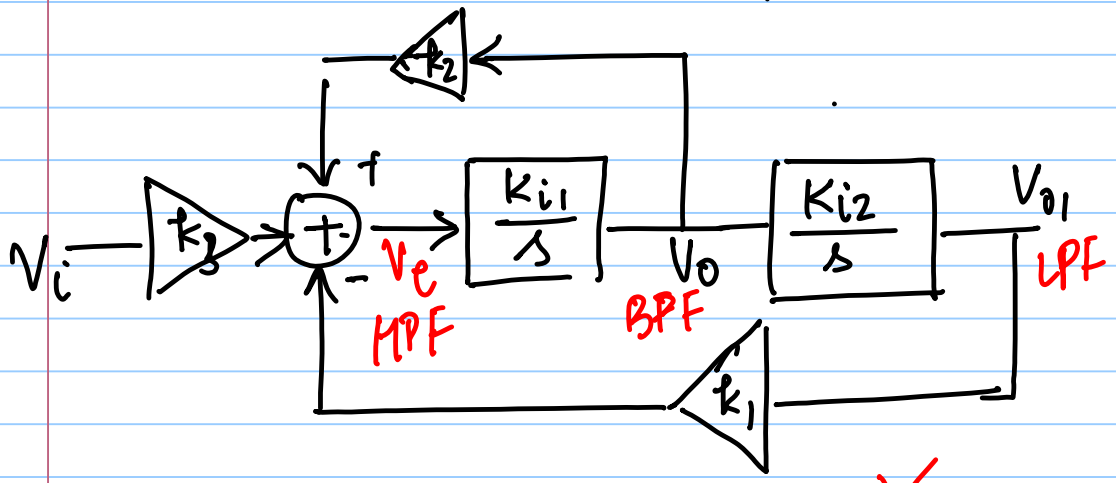
$$\frac{V_i}{R_2} + \frac{V_o}{R_1} - \frac{V_{01}}{R_3} = V_o\,(-sC_1)$$

$$V_o = \frac{-1}{sC_1}\left(\frac{-V_{01}}{R_3} + \frac{V_o}{R_1} + \frac{V_i}{R_2}\right)$$

$$V_o = \frac{-1}{sC_1R_0}\left(\frac{-V_{01}}{R_3/R_0} + \frac{V_o}{R_1/R_0} + \frac{V_i}{R_2/R_0}\right)$$

$$V_o = \frac{-1}{sC_1R_0}\left(k_1V_{01} + k_2V_o + k_3V_i\right) \checkmark$$





✓

$$\frac{V_o}{V_i} = \frac{-(R_1/R_2)s/\omega_0 Q}{\frac{s^2}{\omega_0^2} + \frac{s}{\omega_0 Q} + 1}$$

$$V_o = -\frac{1}{sC_1R_0} V_e$$

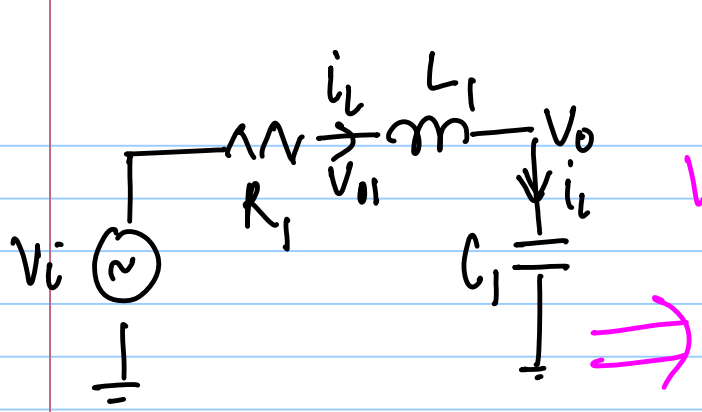
$$\frac{V_e}{V_i} = sC_1R_0 \cdot \frac{V_o}{V_i}$$

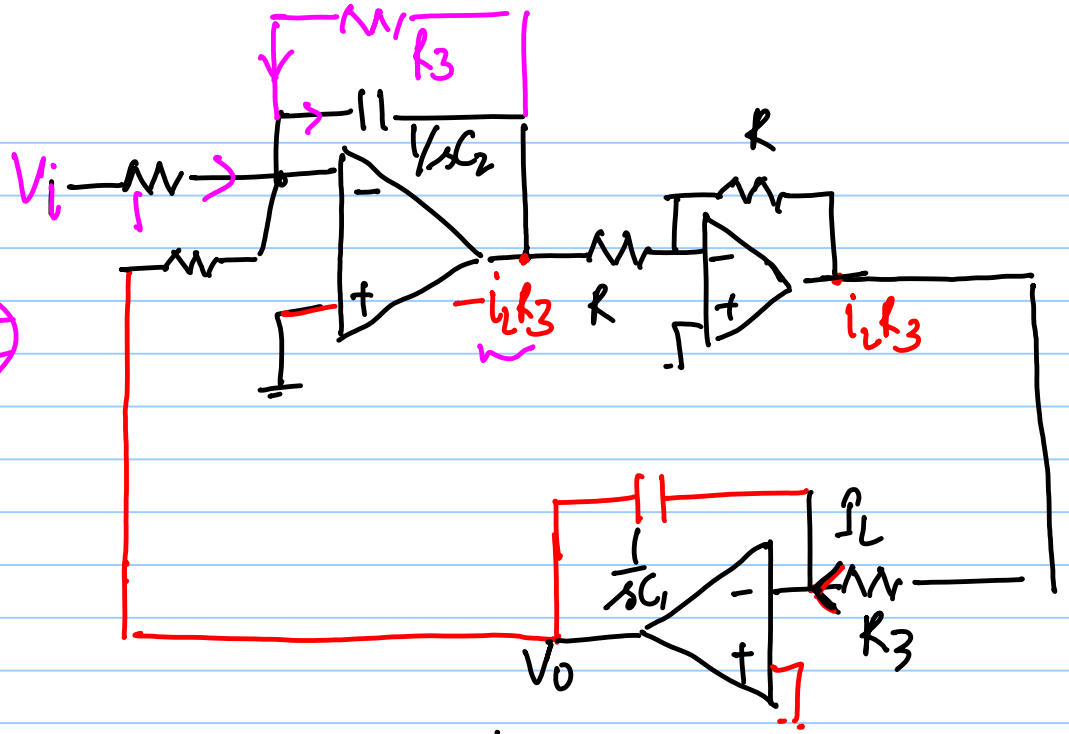
$$= \frac{s^2 (\quad)}{\frac{s^2}{\omega_0^2} + \frac{s}{\omega_0 Q} + 1}$$

$$\frac{V_o}{V_i} = f(k_1, k_2, k_3, K_{i1}, K_{i2})$$

$$\frac{V_e}{V_i} = \frac{s^2 (\quad)}{\frac{s^2}{\omega_0^2} + \frac{s}{\omega_0 Q} + 1}$$

(HPF)





$$i_L = \frac{V_L}{sC}$$

$$i_L = \frac{V_{01} - V_0}{sL_1}$$

$$I_L = \frac{V_0}{sL_1} \quad \text{(Prev. Case)}$$

$$V_0 = \frac{i_L}{sC_1} \qquad V_{01} = V_i - i_L R_1$$