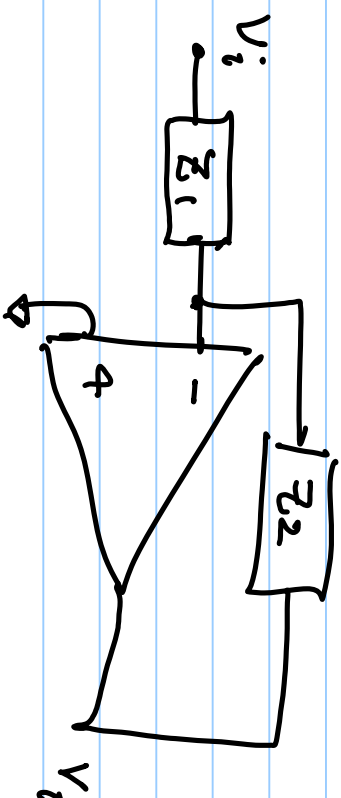
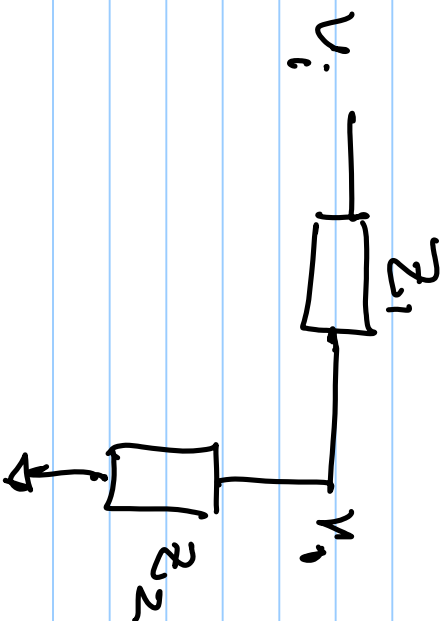
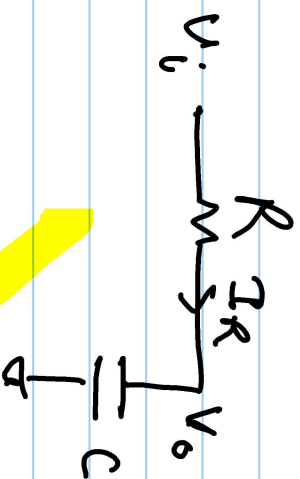


Realization of Analog Filter:



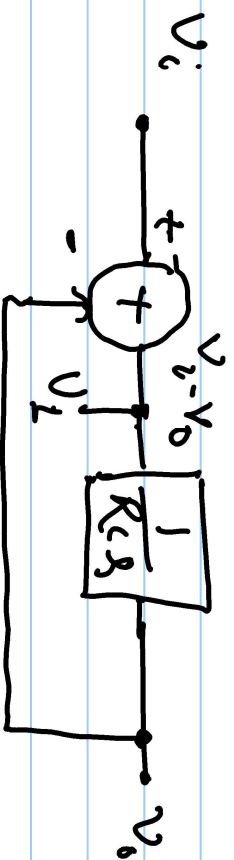
Realizing Filtin using Integrators



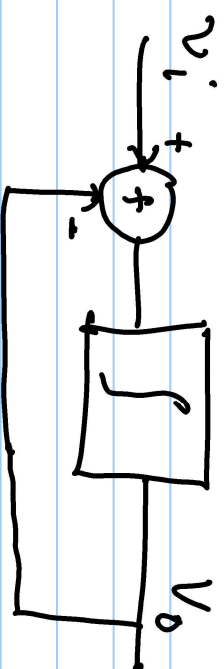
$$V_o = \frac{i_R}{sC}$$

$$i_R = \frac{V_i - V_o}{R}$$

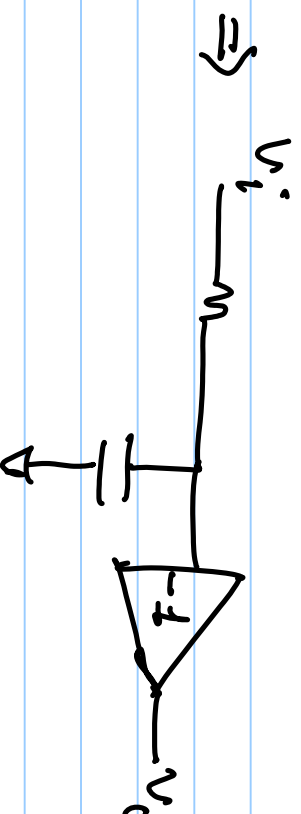
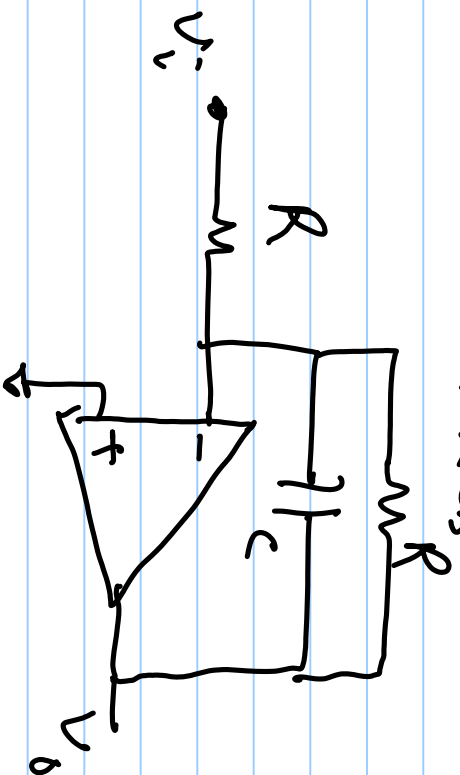
$$V_o = \frac{V_i - V_o}{sRC}$$



$\Rightarrow$



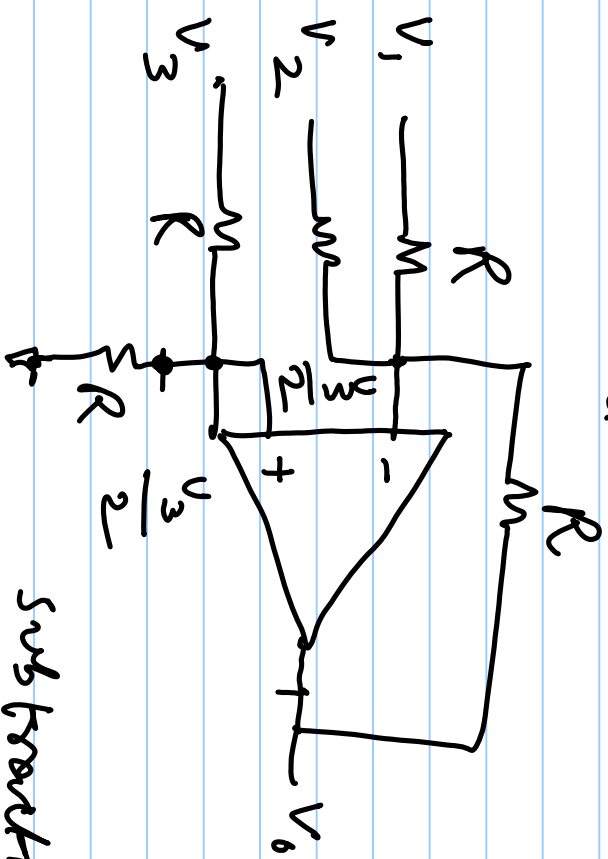
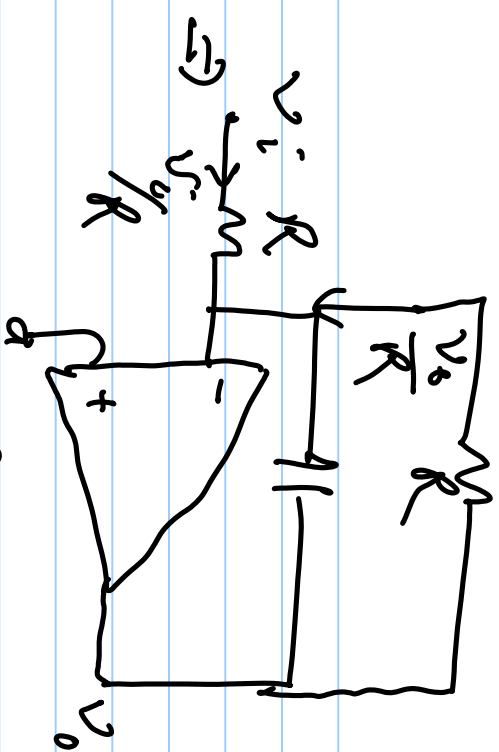
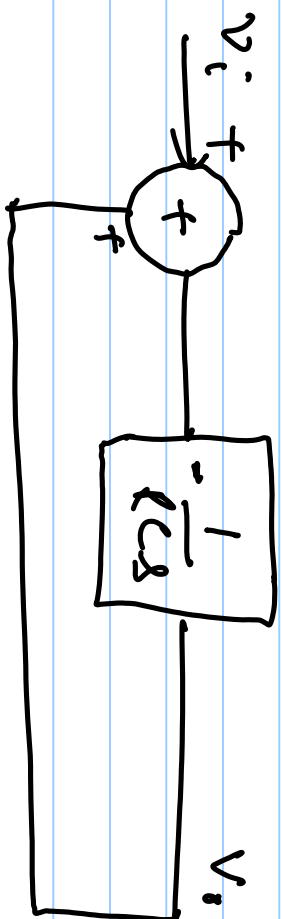
$$V_o = \frac{1}{1+Rc_s} \quad , \quad V_1 = \frac{Rc_s}{1+Rc_s}$$



$$V_o = \frac{V_i - V_o}{Rc_s}$$

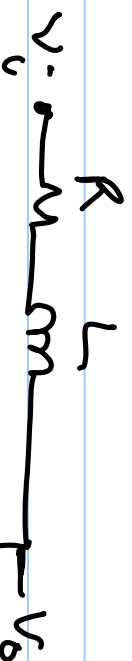
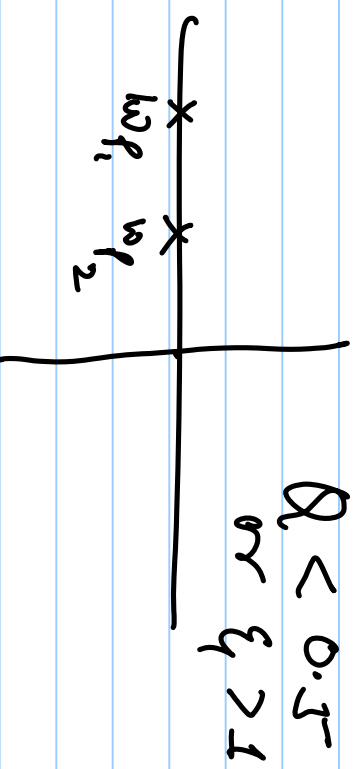
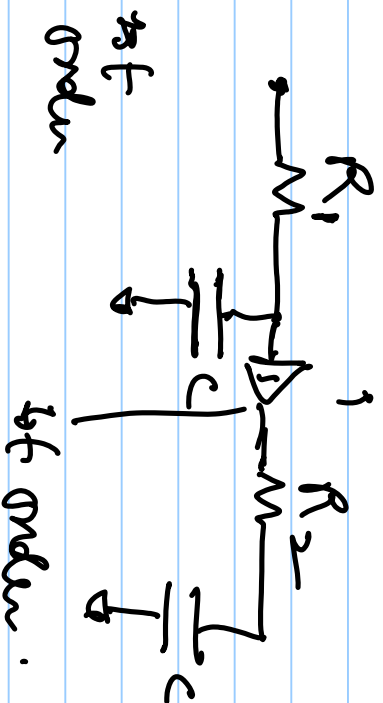
replace V_o with $-V_o$

$$V_o = - \left(\frac{V_i + V_o}{Rc_s} \right)$$

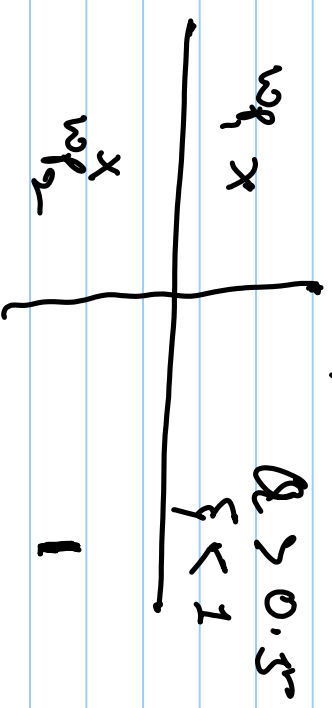


Subtractor

Second Order Filter

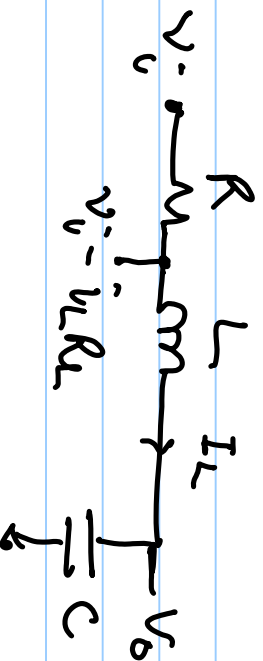


$$Q = \frac{1}{2\zeta}$$



In order to realize high-Q filter we need Inductor.

Inductors are expensive and bulky so we always want to realize $\log 10$ filter using R & C



$$v_o = \frac{i_L}{sC} \quad \text{--- (1)}$$

$$i_L = \frac{v_i - i_L R - v_o}{sL} \quad \text{--- (2)}$$

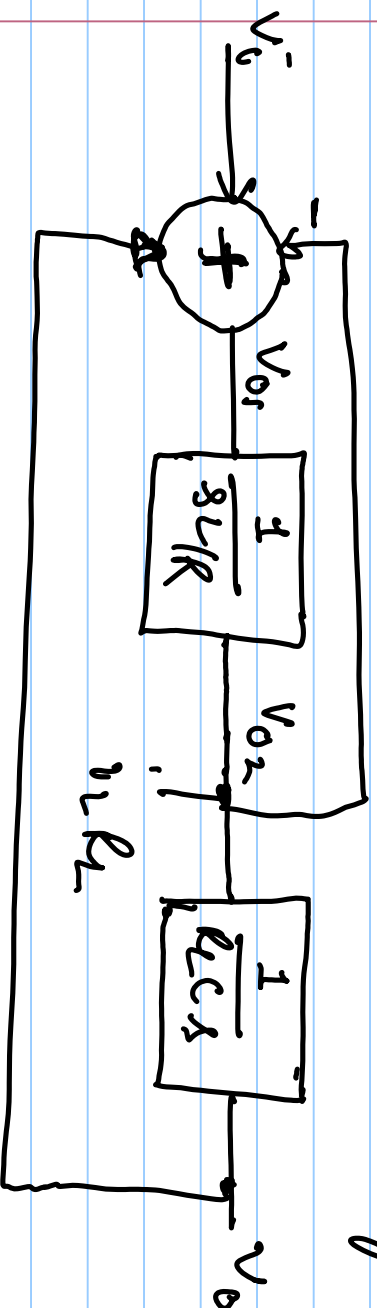
eq-① can be written as

$$v_o = \frac{i_L R}{R + sC R}$$

eq-② can be written as.

$$i_L R_L = \frac{v_i - i_L R_L - v_o}{sL/R} \quad \text{--- ②}$$

both ① & ② have integration



$$v_o = \frac{i_L R_L}{sC R_L}$$

$$V_0 = \frac{1}{LCs^2 + R_LCs + 1} \quad \text{L.P.F.}$$

$$V_{0L} = \frac{R_LCs}{LCs^2 + R_LCs + 1} \quad \text{B.P.F.}$$

$$V_{0I} = \frac{R_LCs \left(\frac{L}{R_L} s \right)}{LCs^2 + R_LCs + 1} = \frac{LCs^2}{LCs^2 + R_LCs + 1} \quad \text{H.P.F.}$$

$$H(s) = \frac{a_1s^2 - b_1s + c_1}{a_2s^2 + b_2s + c_2}$$

$\xrightarrow{\text{HPF}} \quad \xrightarrow{\text{BPF}} \quad \xrightarrow{\text{LPF}}$