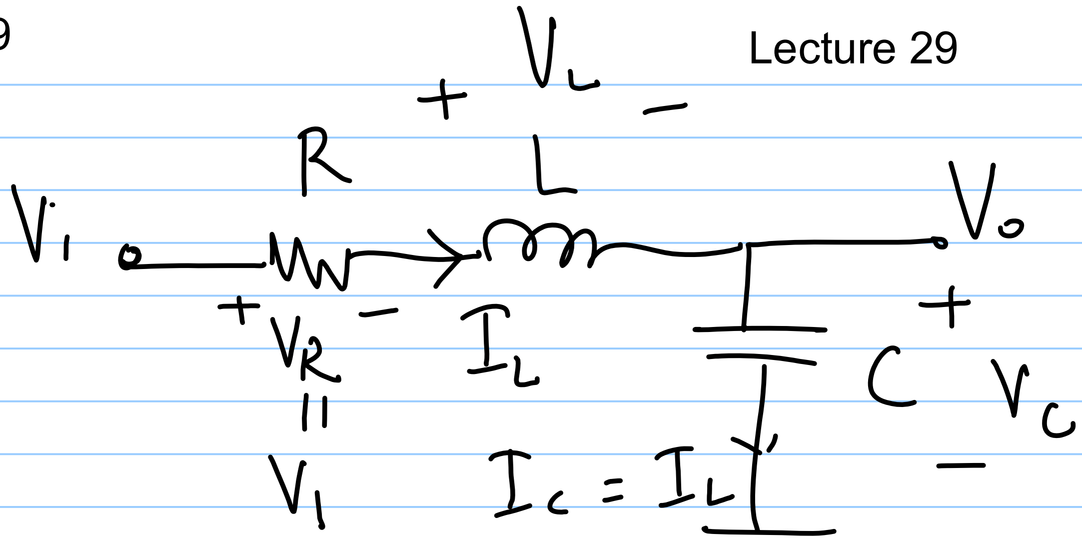
19/03/2019

Lecture 29



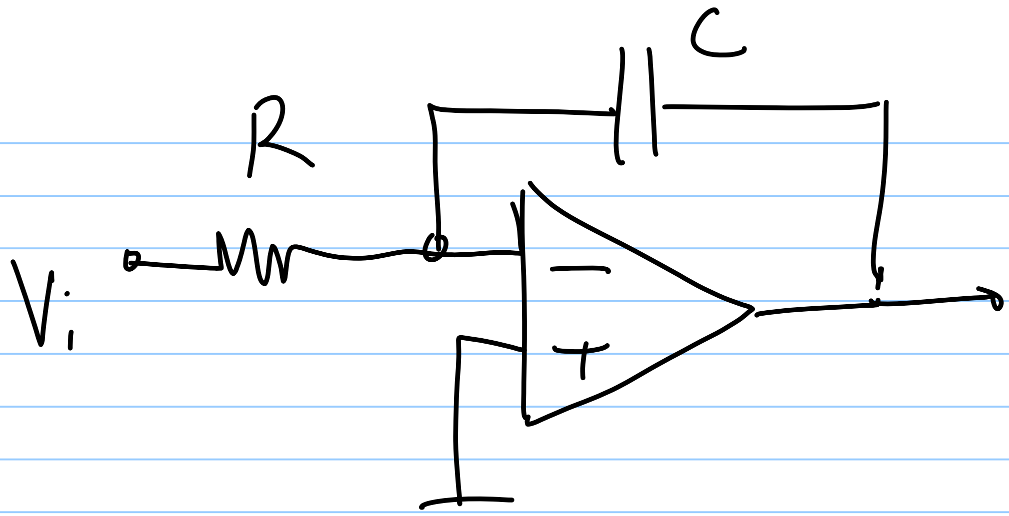
L- bulky

"State Variable" Filter

* Integrator is the basic building block

$$\frac{V_o(s)}{V_i(s)} = \frac{1/sC}{R + sL + 1/sC} = \frac{1}{1 + sCR + s^2 LC}$$

$$\text{Integrator} = \frac{(\ )}{s(\ )}$$



$$V_o = \frac{-1}{sCR} \cdot V_i$$

$$I_c = c\,\frac{dV_c}{dt}$$

$$I_c(s) = sC\,V_c(s)$$

$$R \cdot I_L(s) = sCRV_c(s)$$

$$V_1(s) = sCR\,V_c(s)$$

$$V_c(s) = \frac{V_1(s)}{sCR} \quad (1)$$

$$V_L = L\frac{dI_L}{dt}$$

$$V_L(s) = sL\,I_L(s)$$

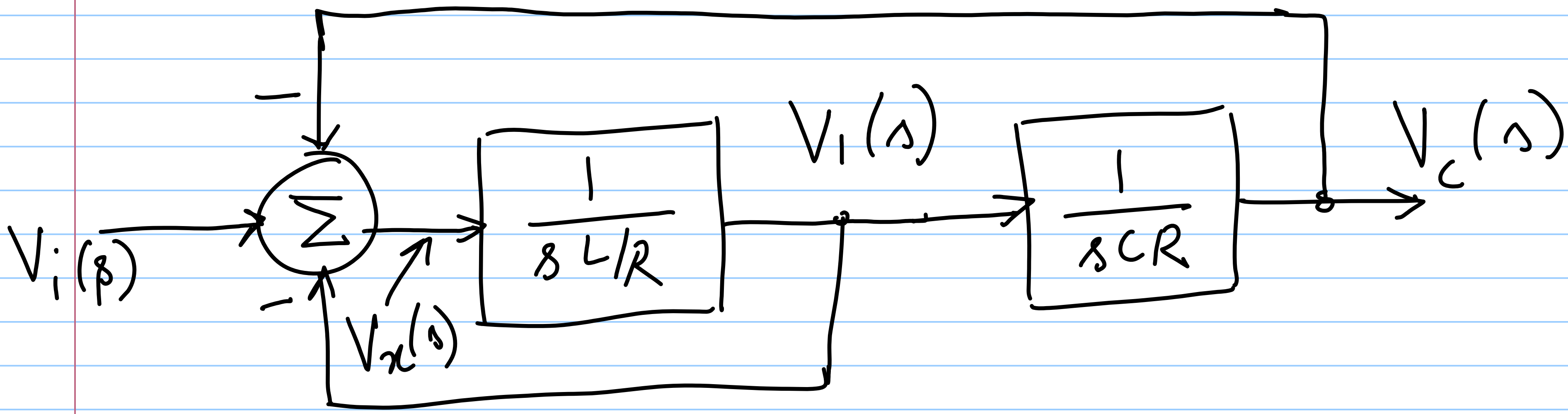
$$I_L(s) = \frac{V_L(s)}{sL}$$

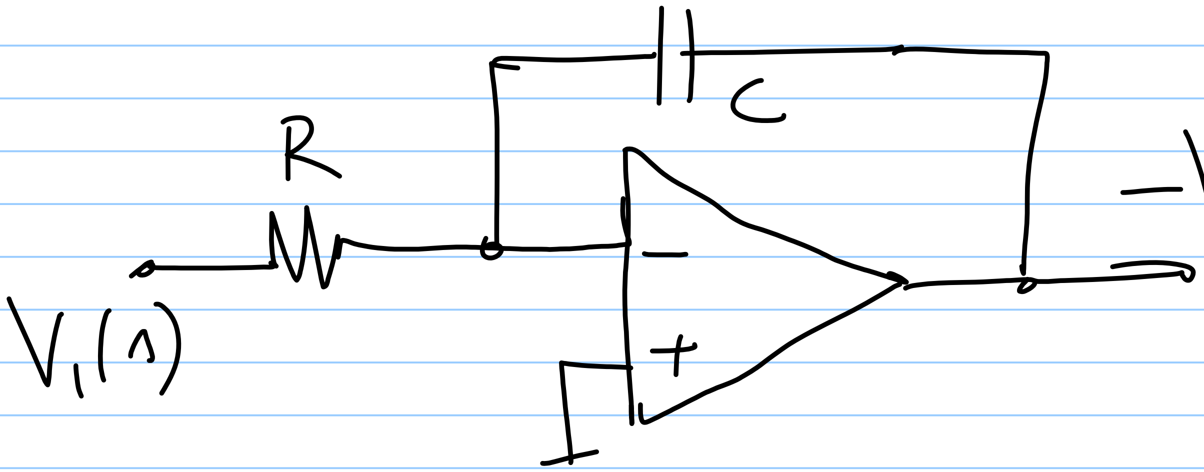
$$V_i = V_R + V_L + V_C$$

$$V_i(s) = I_L(s)R + V_L(s) + V_C(s)$$

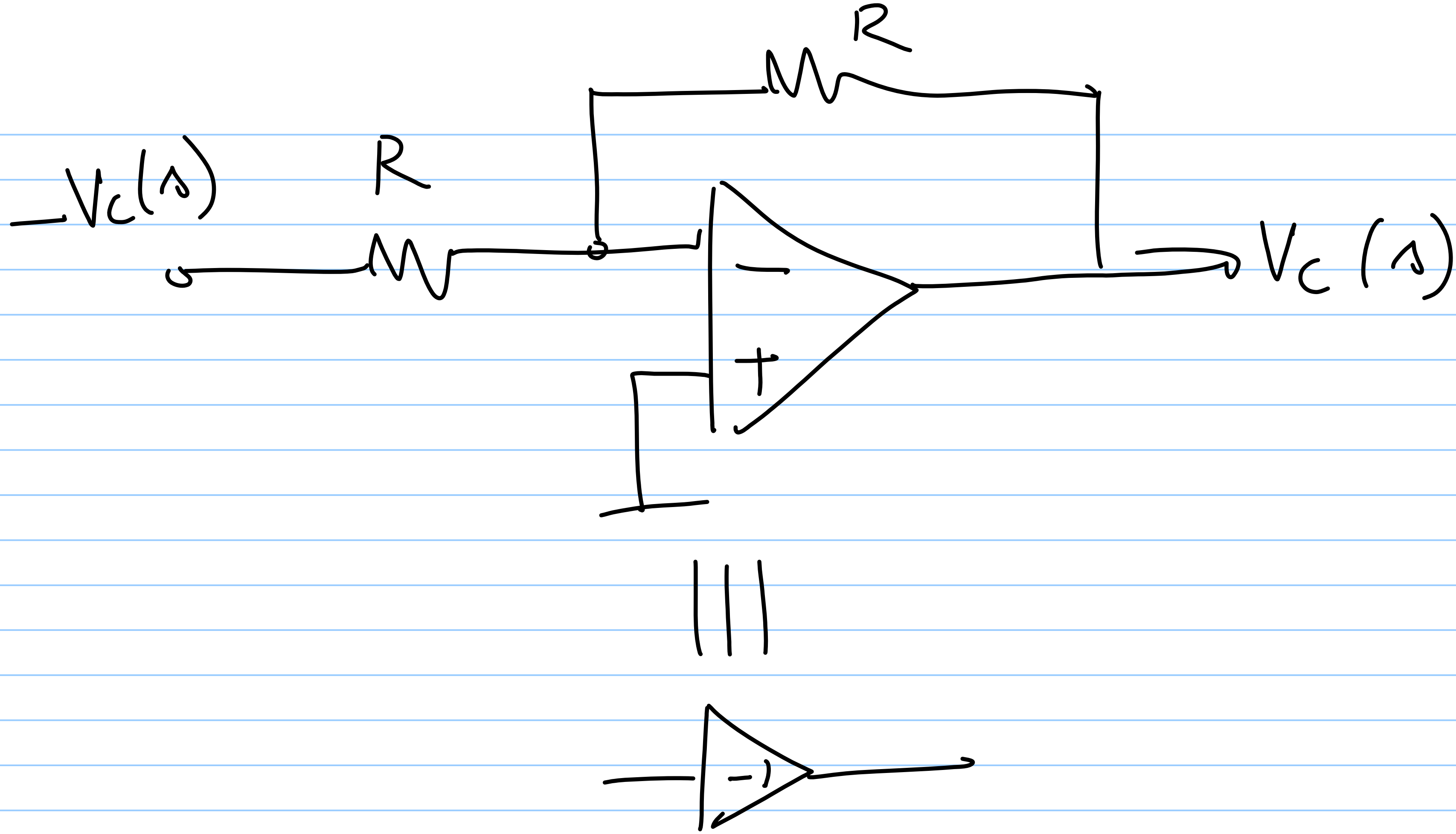
$$V_1(s) = R \cdot I_L(s) = \frac{V_i(s) - RI_L(s) - V_C(s)}{sL/R}$$

$$V_1(s) = \frac{V_i(s) - V_1(s) - V_C(s)}{sL/R} \quad \text{— } 2$$

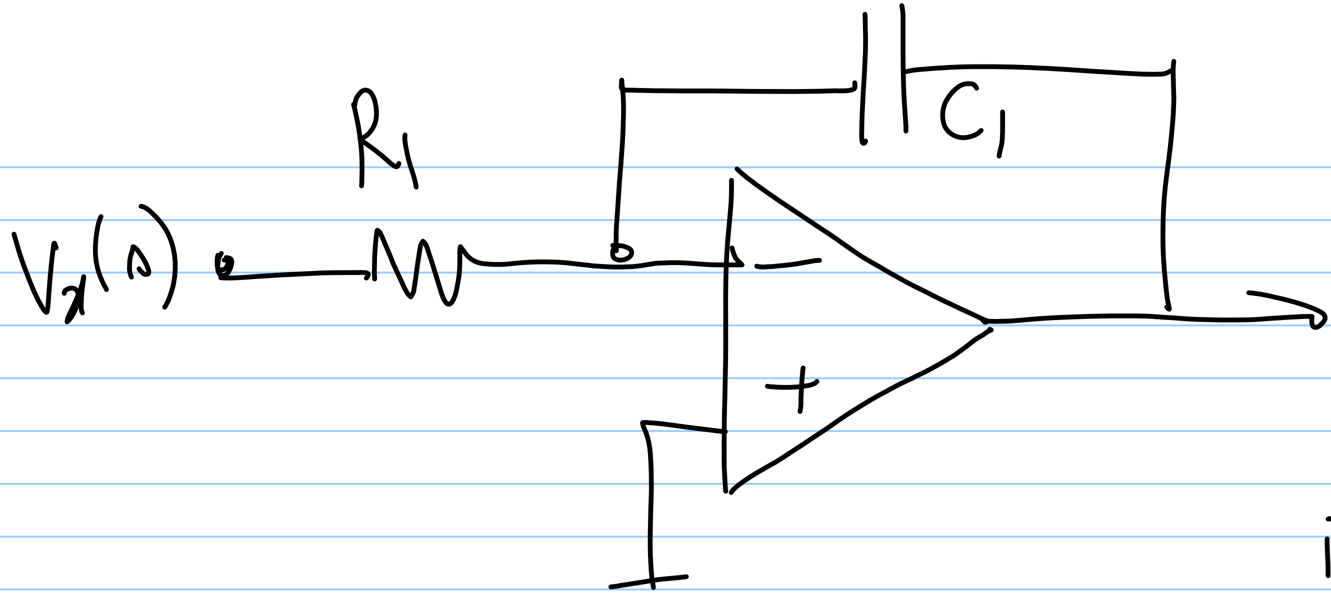




$-V_1/sCR = -V_c(s)$

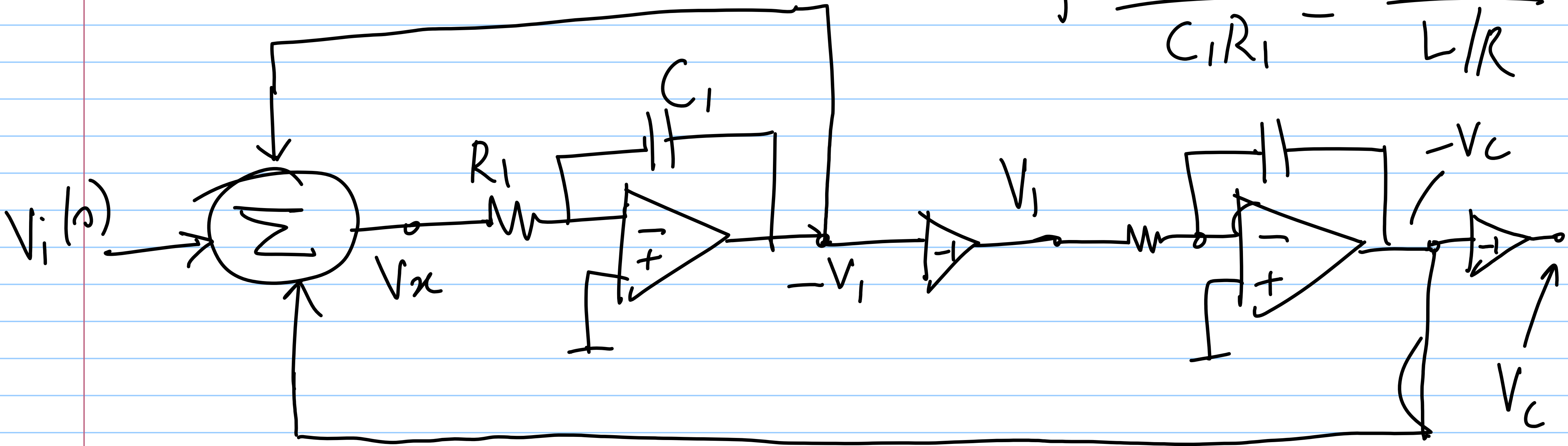


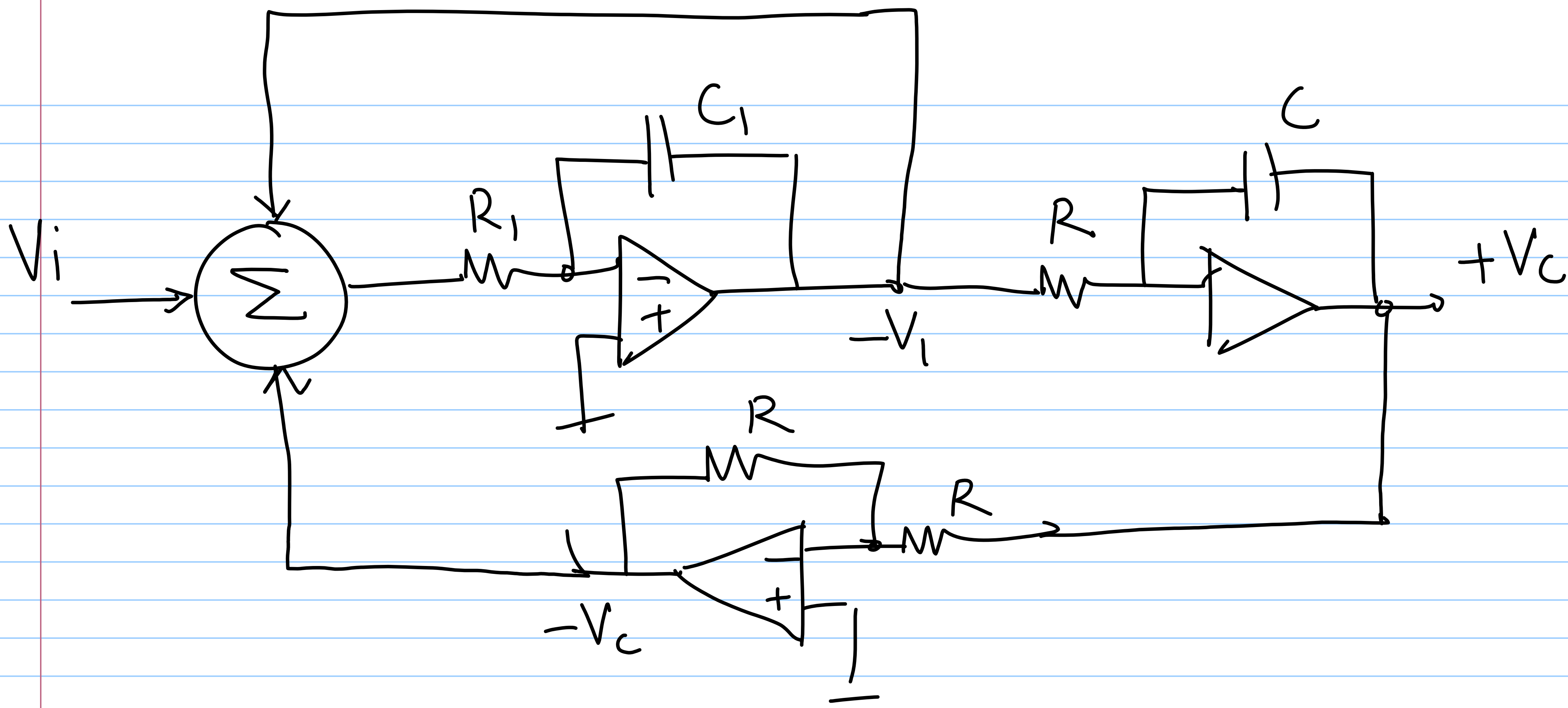
$-V_C(s)$
R
R
−
+
$V_C(s)$
−1



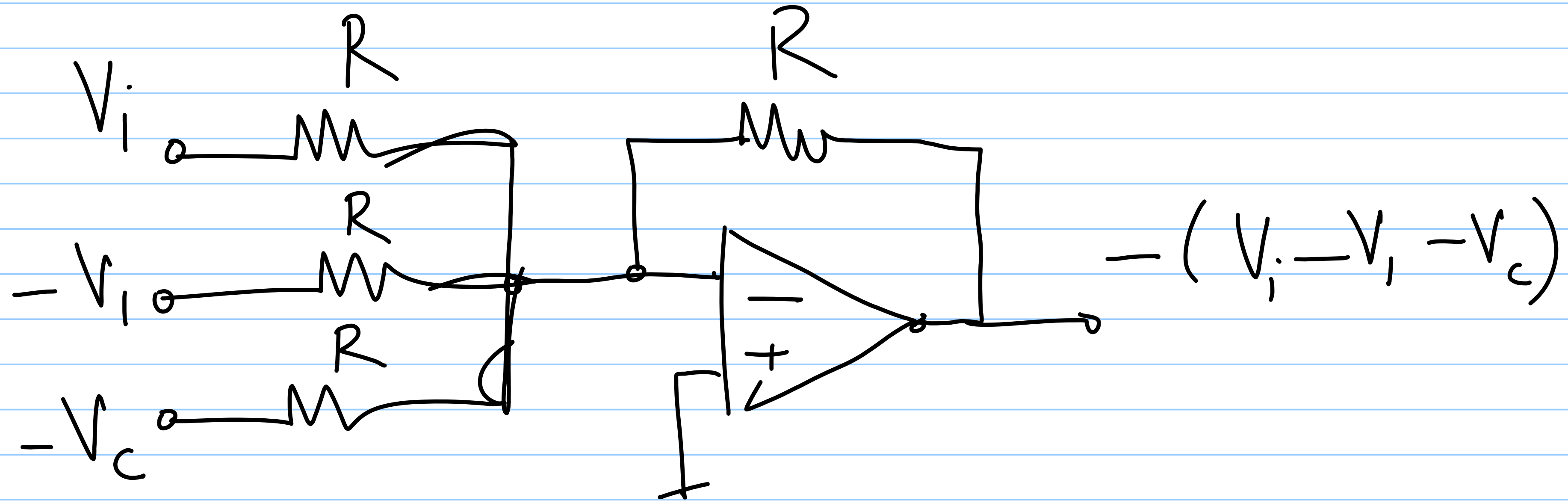
$$\frac{-V_x(s)}{sC_1R_1} = -V_1(s)$$

$$\text{if } \frac{1}{C_1R_1} = \frac{1}{L/R}$$



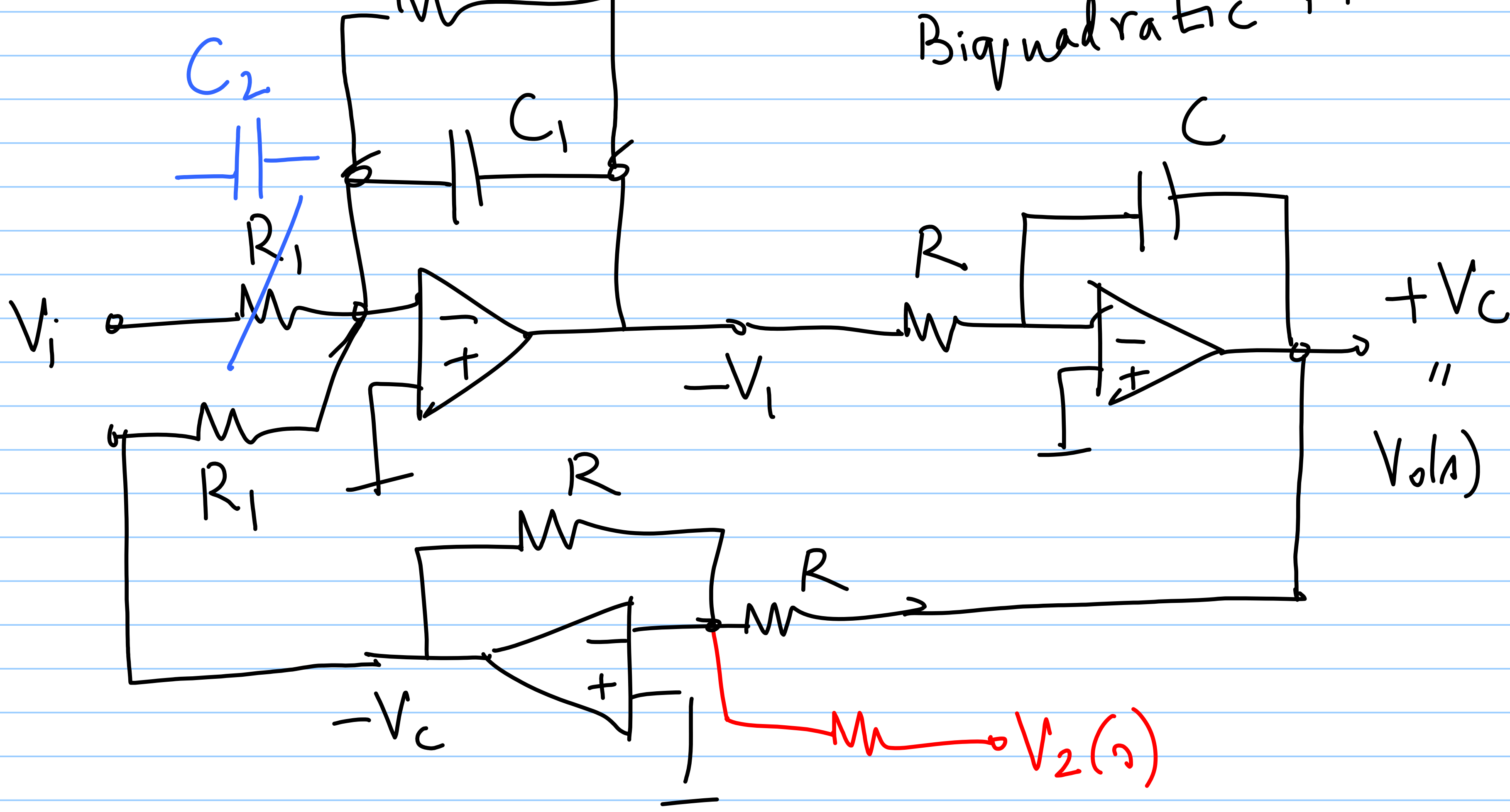


V_i
Σ
R_1
C_1
$-V_1$
R
C
$+V_C$
R
R
$-V_C$



R
R
R
R
V_i
$-V_1$
$-V_c$
$-(V_i - V_1 - V_c)$

"Tow-Thomas"
Biquadratic Filter



$$-V_1 = \frac{-V_i(s) + V_1(s) + V_c(s)}{sC_1R_1}$$

$$-V_1 = \frac{-1}{sC_1R_1}\left[V_i(s) - V_1(s) - V_c(s)\right]$$

$$\frac{V_o(s)}{V_i(s)} = \frac{1}{1 + sCR + s^2 LCRC_1R_1}$$

$$V_c(s) = \frac{V_1(s)}{sCR}$$

$$\frac{V_1(s)}{V_i(s)} = sCR \cdot \frac{V_c(s)}{V_i(s)}$$

$$= \frac{sCR}{1 + sCR + sC_1R_1CR}$$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