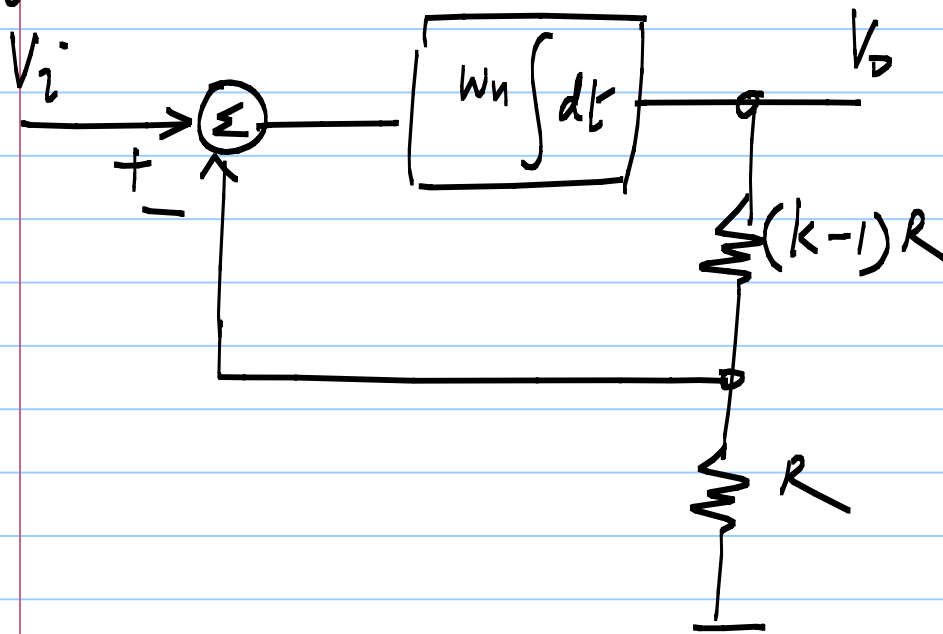


Lecture #5, Analog IC Design

Note Title

12/24/2010

Negative feedback amplifier



$$\text{time constant} = \frac{k}{\omega_n}$$

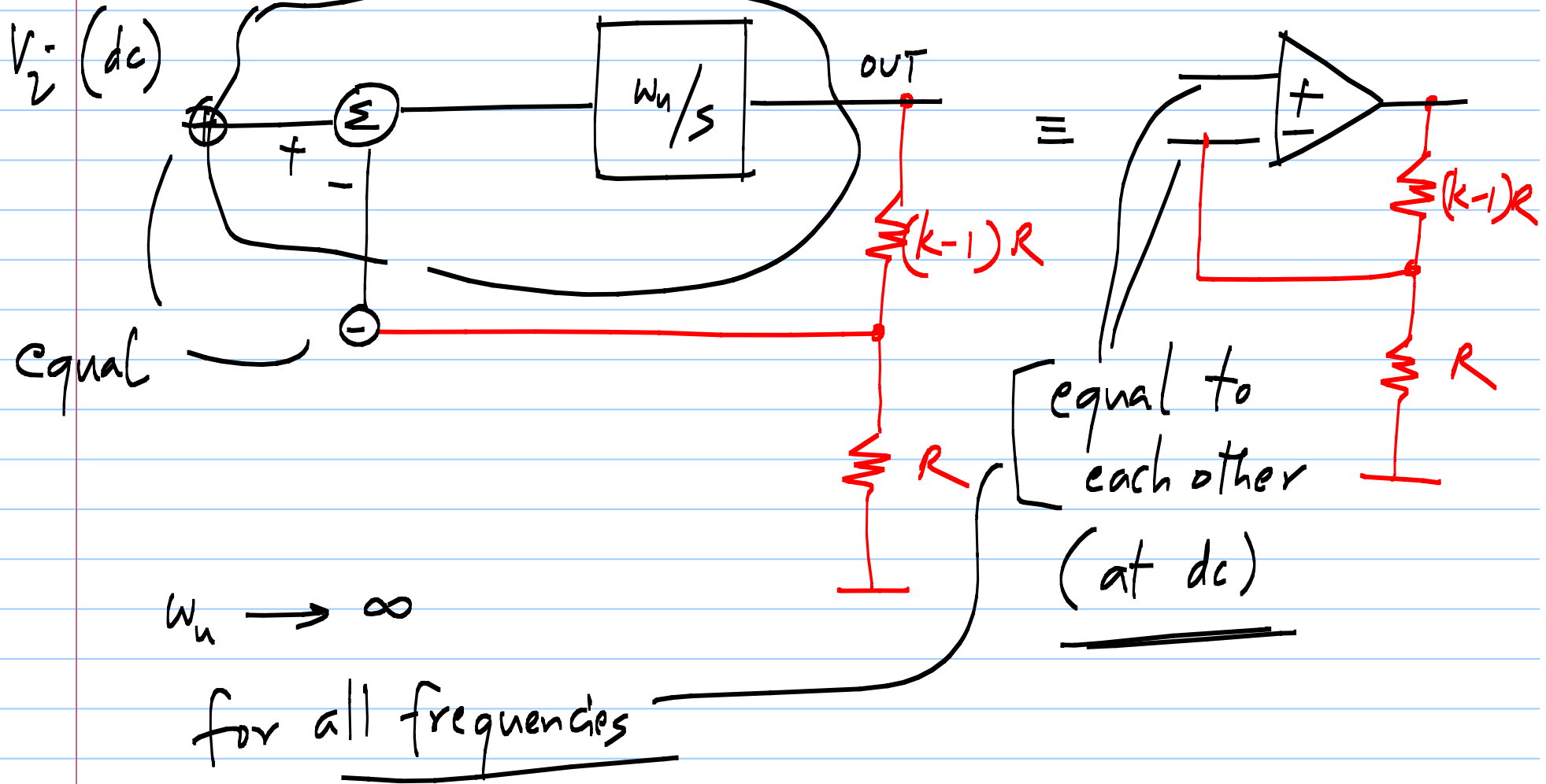
$$\text{bandwidth} = \frac{\omega_n}{k}$$

$$\omega_{n, \text{loop}} = \frac{\omega_n}{k}$$

Operational amplifier: (OPAMP)

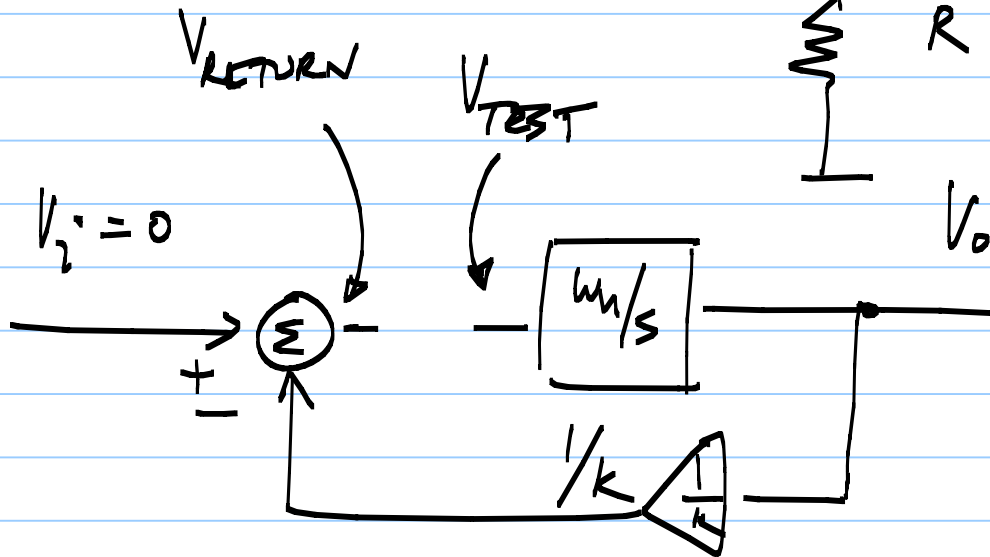
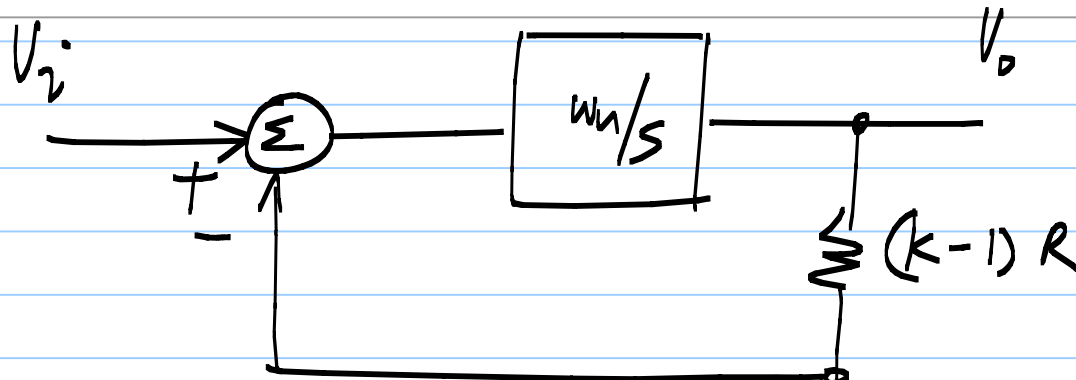
Note Title

12/24/2010



Loop gain:

Note Title



$$V_{\text{RETURN}} = -L(s) \cdot V_{\text{TEST}}$$

Loop gain

$$|L(s)| \gg 1$$

strong negative feedback

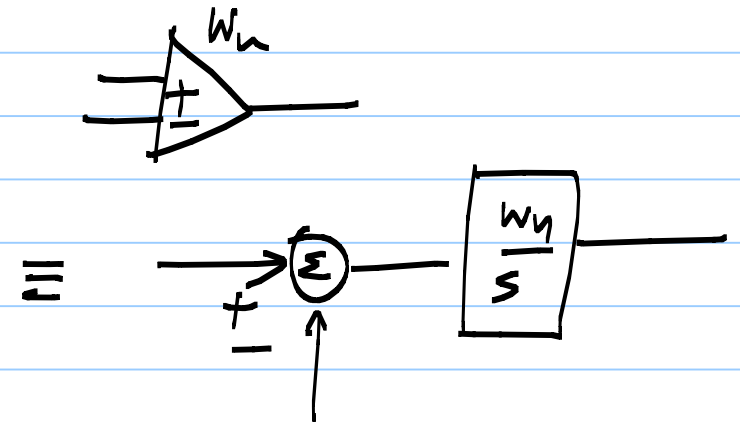
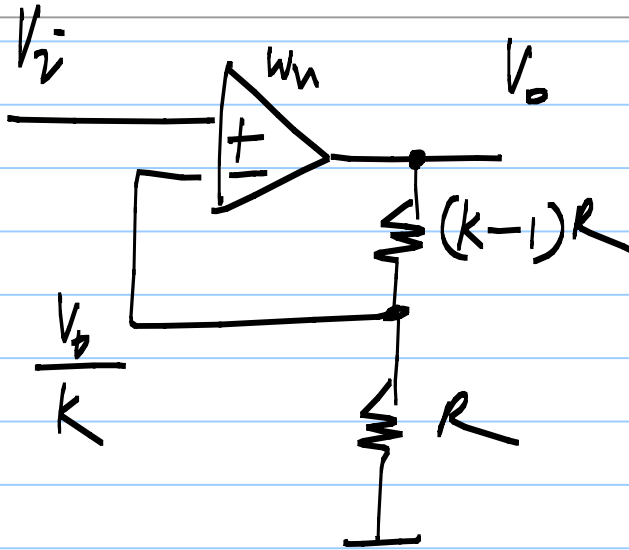
Other amplifiers using an opamp.

Note Title

12/24/2010

VCVS:

$$V_o = k \cdot V_i$$



CCVS:

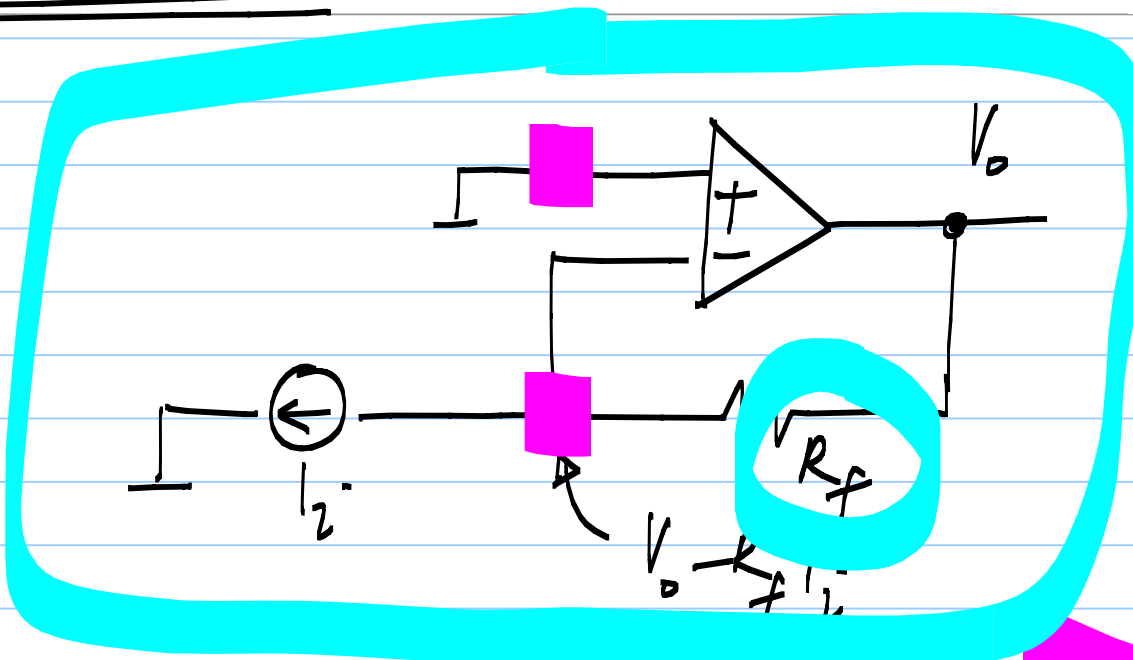
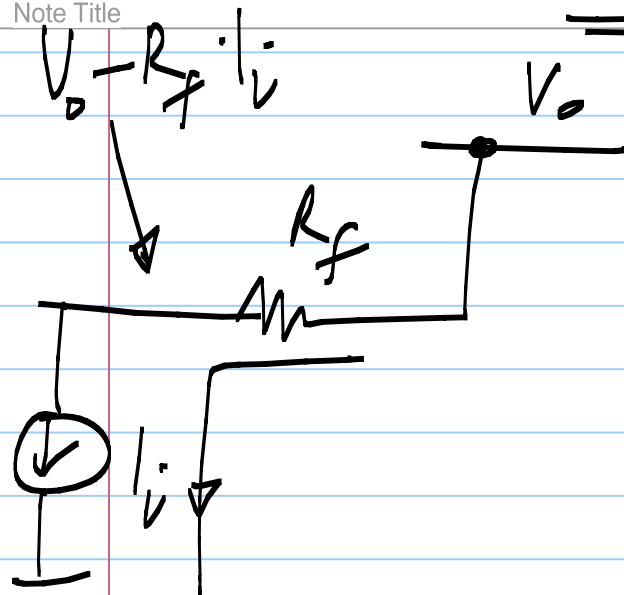
$$V_o = R_f \cdot I_i$$

CCVS :

$$\underline{V_o = R_f \cdot i_i}$$

Note Title

12/24/2010



$$(V_o - R_f \cdot i_i) > 0$$

reduce V_o

$$(V_o - R_f \cdot i_i) < 0$$

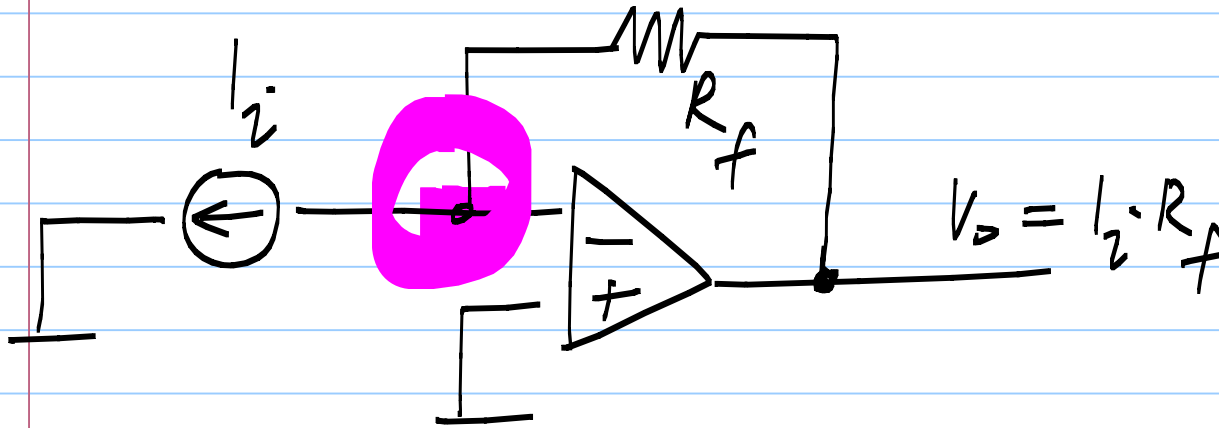
increase V_o

CCVS:

$$V_o = I_i \cdot R_f$$

Note Title

12/24/2010

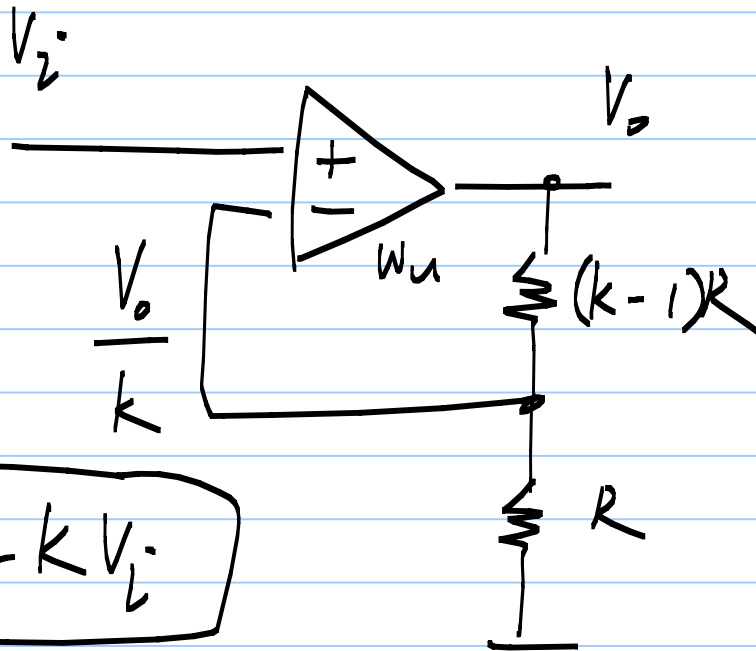


I_i (dc)

VCVS

Note Title

12/24/2010

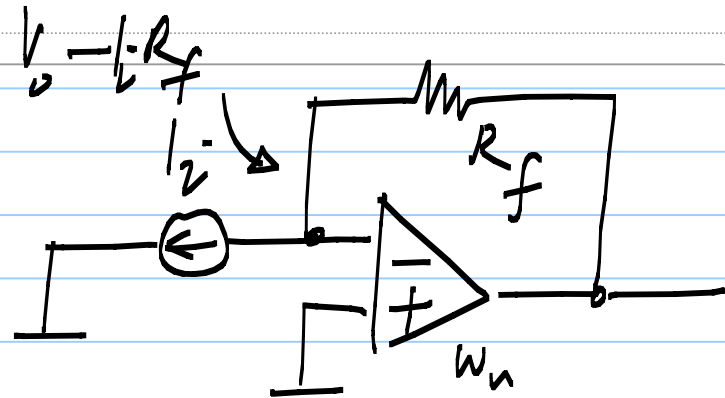


$$V_o = k V_i$$

dc: $V_o/k = V_i$

$w_u \rightarrow \infty$ for all freq. $\frac{V_o}{k} = V_i$

CCVS



$$V_o = I_i \cdot R_f$$

$$V_o - I_i \cdot R_f = 0$$

$V_o - I_i \cdot R_f = 0$ **IDEAL**

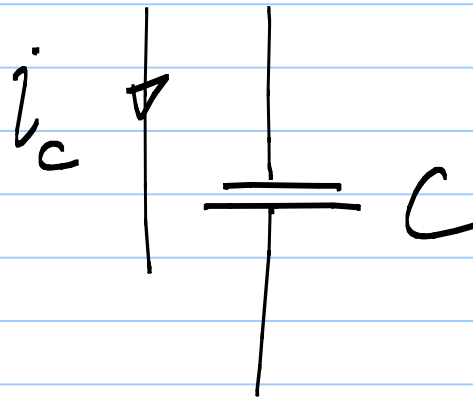
Integrator realization:

Note Title

12/24/2010

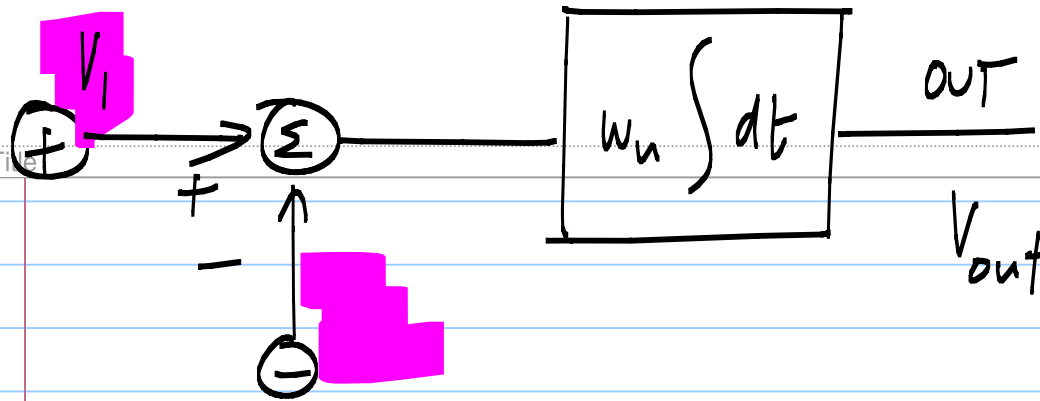
Integration using L or C

↓
Impractical

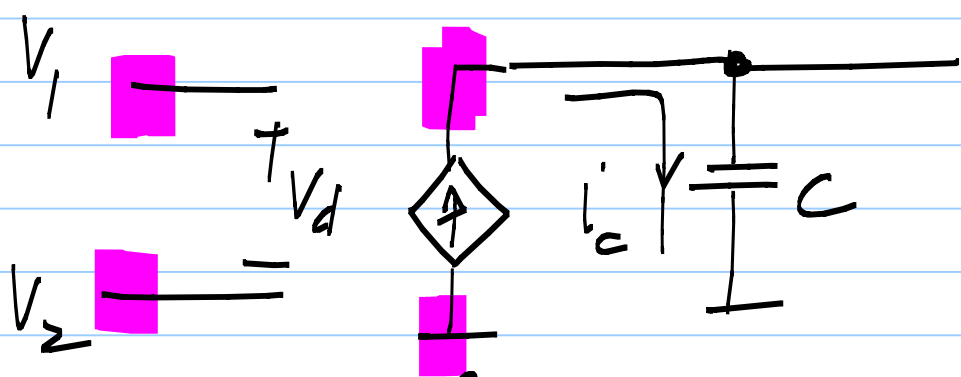


A circuit diagram showing a capacitor. A vertical line on the left has a downward-pointing arrow labeled i_c . A horizontal line in the middle represents the capacitor, with the letter C to its right. A vertical line on the right has a plus sign at the top and a minus sign at the bottom, with the label v_c between them.

$$v_c = \frac{1}{C} \int i_c \cdot dt$$



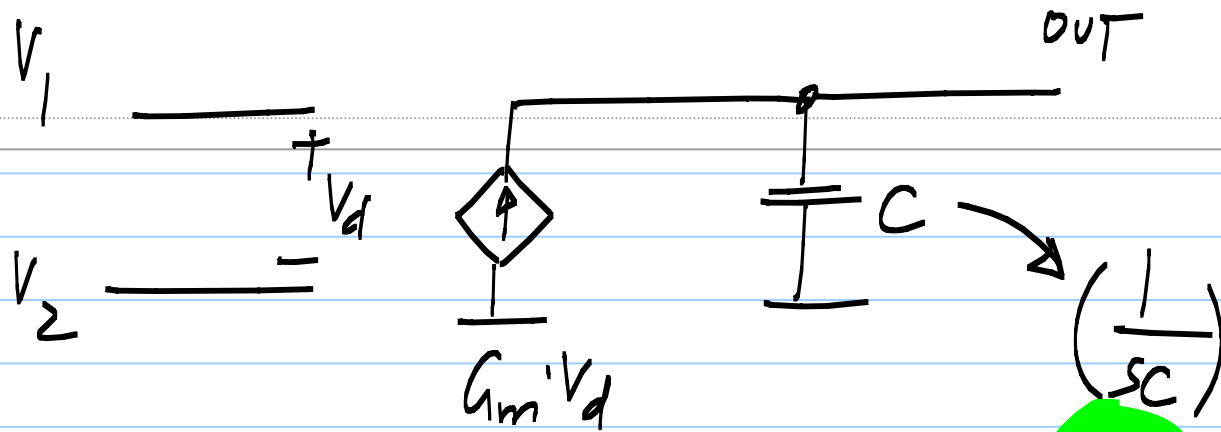
$$V_{out} = \omega_n \int (V_1 - V_2) dt$$



$$\frac{G_m}{C} \int V_d \cdot dt$$

$$i_c = G_m \cdot V_d$$

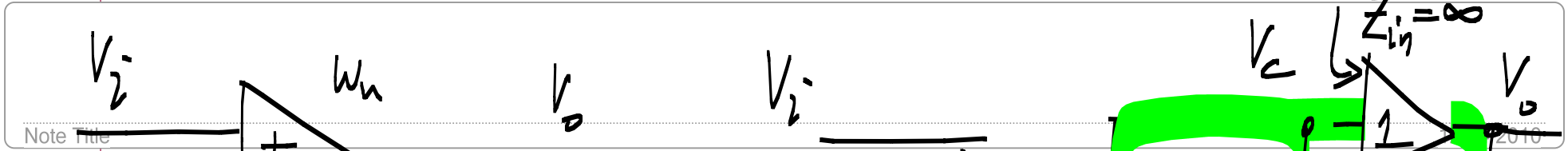
$$= \frac{G_m}{C} \int (V_1 - V_2) dt$$



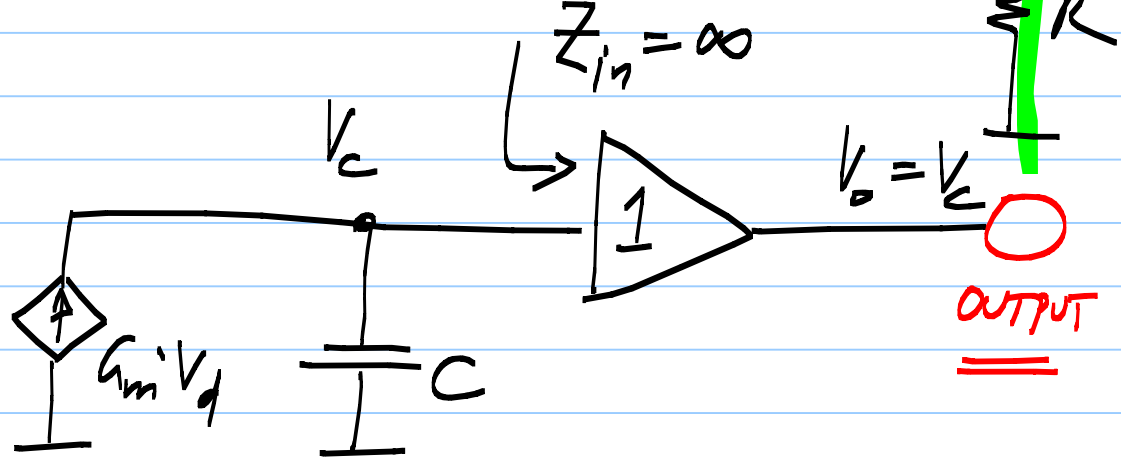
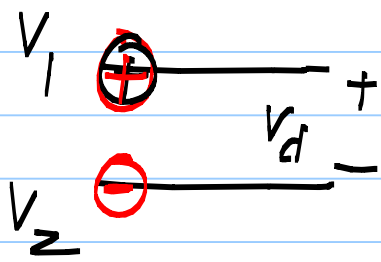
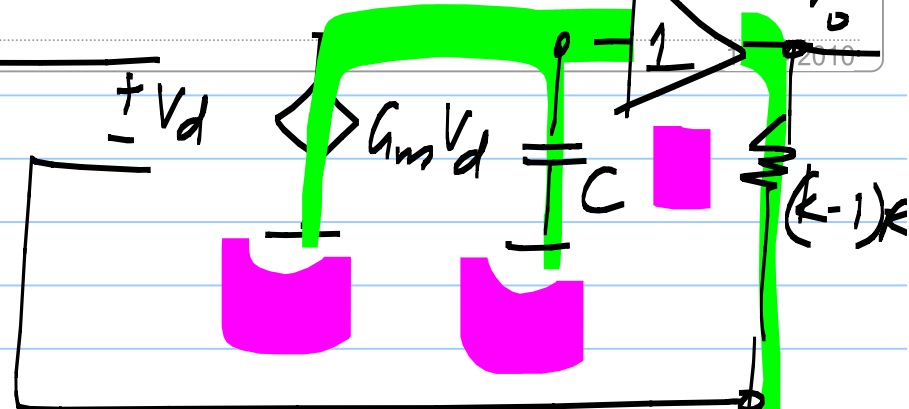
$$V_{out} = G_m \cdot V_d \cdot \frac{1}{sC} = \frac{G_m}{s} (V_1 - V_2)$$

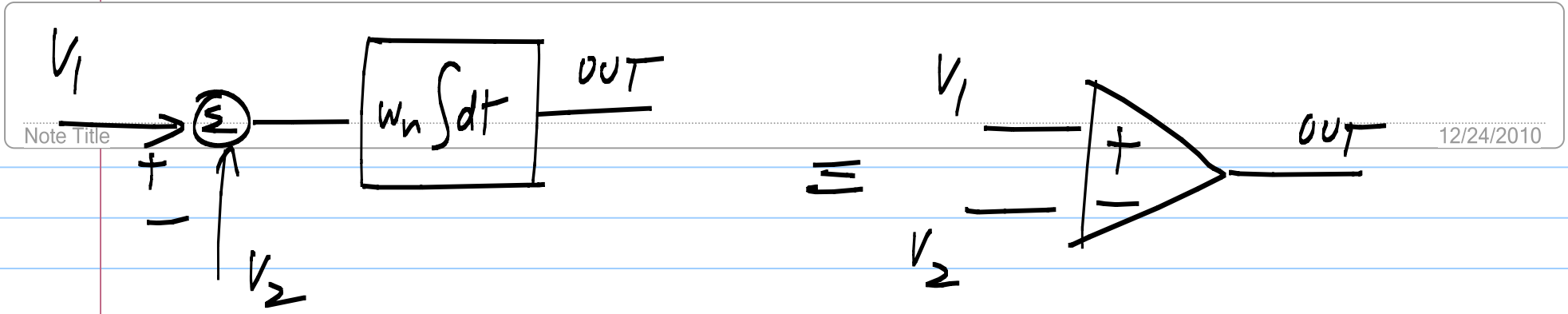
$$V_{out} = \frac{W_u}{s} (V_1 - V_2)$$

$$W_u = \frac{G_m}{C}$$



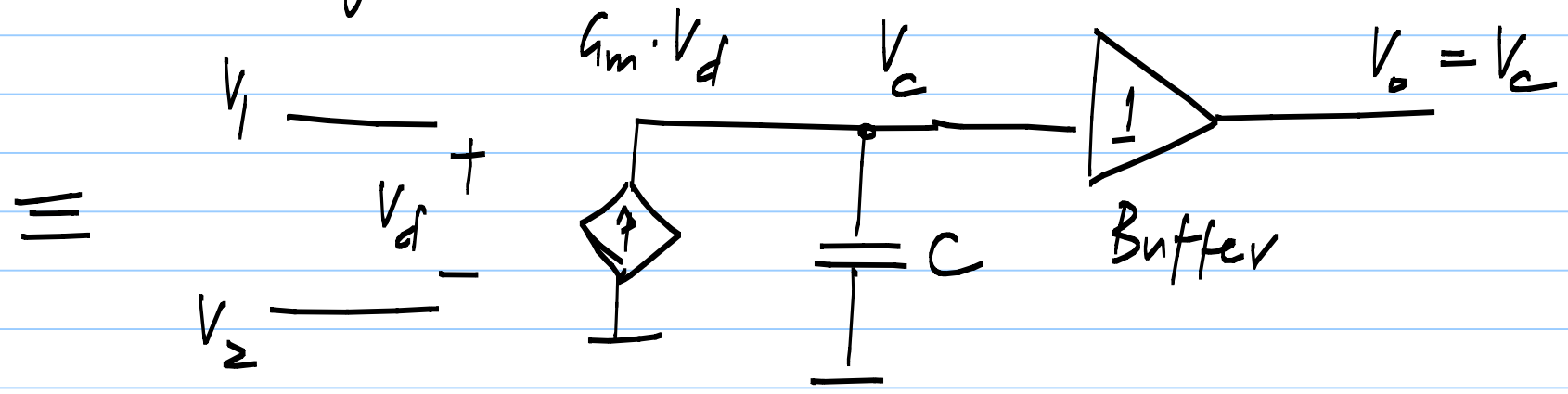
Note file





Take the difference
& integrate

opamp



Realization

