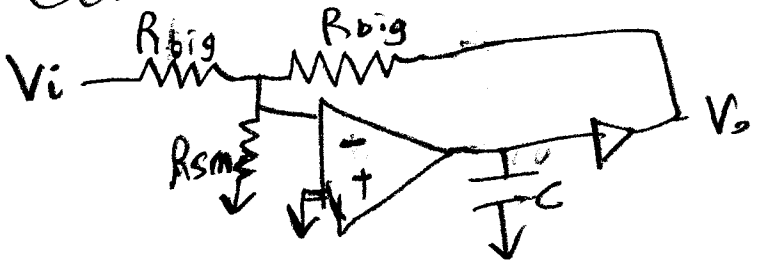
Spring 00

ECE 4083 HW#4 Soln's

1) General Structure



a) $V_- = \left(\frac{R_{sm} \| R_{big}}{R_{big} + R_{sm} \| R_{big}}\right)(V_i + V_o)$

b) $V_- = \left(\frac{R_{sm}}{R_{big} + R_{sm}}\right)(V_i + V_o)$

c) $V_- = \left(\frac{R_{sm}}{R_{big}}\right)(V_i + V_o)$

Specifics:

	SSM2040	Wilson	Polyfusion
R_{sm} ; R_{big}	200Ω ; 10K	1K ; 100K	100Ω ; 20K
C	1000pF	100pF	100pF
$\frac{R_{sm} \| R_{big}}{R_{big} + R_{sm} \| R_{big}}$	0.0192	0.0098	0.00495
$\frac{R_{sm}}{R_{big} + R_{sm}}$	0.0196	0.0099	0.00498
$\frac{R_{sm}}{R_{big}}$	0.02	0.01	0.005

d) General: $g_m = 19.2 I_{CON}$

$$(-V_i - V_o)\left(\frac{R_{sm}}{R_{big}}\right) 19.2 I_{CON} = V_o C_s$$

$$V_o\left(C_s + \frac{R_{sm}}{R_{big}} 19.2 I_{CON}\right) = -V_i\left(\frac{R_{sm}}{R_{big}} 19.2 I_{CON}\right)$$

$$V_o = -V_i \frac{1}{1 + \left(\frac{R_{big}}{R_{sm}} \frac{1}{19.2 I_{CON}} C_s\right)}$$

don't forgee the minus sign!

call this τ

SSM 2040: $\tau = 2.604 \times 10^{-9} / I_{CON}$

Wilson: $\tau = 5.208 \times 10^{-10} I_{CON}$

Polyfusion: $\tau = 1.042 \times 10^{-9} / I_{CON}$

f) $F_c = \frac{1}{2\pi\tau}$

SSM2040: $6.112 \times 10^7 I_{CON}$

Wilson: $3.056 \times 10^8 I_{CON}$

Polyfusion: $1.527 \times 10^8 I_{CON}$

e) DC gain = -1

2) $|H(j2\pi f)|^2 = \frac{1}{1+\left(\frac{f}{f_1}\right)^2}$

$|H(j2\pi f_4)|^4 = \frac{1}{\sqrt{2}} = \left(\frac{1}{1+\left(\frac{f_4}{f_1}\right)^2}\right)^2$

$= \frac{1}{\sqrt{2}} = \frac{1}{1+\left(\frac{f_4}{f_1}\right)^2}$

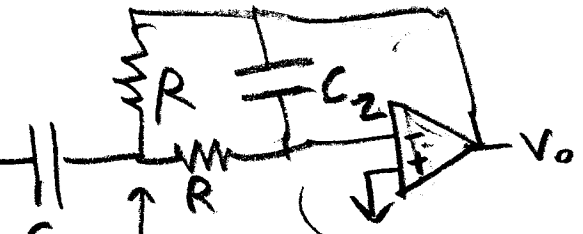
$\sqrt{2} = 1+\left(\frac{f_4}{f_1}\right)^2$

$f_c^2\left(\sqrt{2}-1\right) = f_4^2$

$f_4 = f_c\sqrt{\sqrt{2}-1}$

$\approx \boxed{0.435 f_c}$

3)



$$V_x = \frac{V_i C_1 s + \frac{V_o}{R}}{C_1 s + \frac{2}{R}} \qquad \frac{V_x}{R} + V_o C_2 s = 0$$

$$V_x = -V_o R C_2 s$$

$$-RC_2 s V_o = \frac{V_i C_1 s + \frac{V_o}{R}}{C_1 s + \frac{2}{R}}$$

$$-RC_1C_2 s^2 V_o - 2C_2 s V_o = V_i C_1 s + \frac{V_o}{R}$$

$$-V_o\left(R^2 C_1 C_2 s^2 + 2RC_2 s + 1\right) = V_i RC_1 s$$

$$\boxed{\frac{V_o}{V_i} = -\frac{RC_1 s}{R^2 C_1 C_2 s^2 + 2RC_2 s + 1}}$$