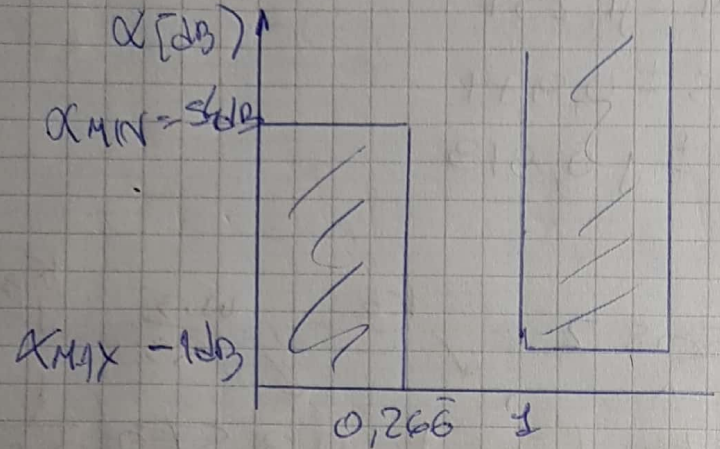
8) $\alpha_{MIN} = 53,98 dB$ $\quad \omega_p = 2\pi 45 KHz$

$\alpha_{MAX} = 1 dB$ $\quad \omega_s = 2\pi 72 KHz$



$\Omega_s = 3,75$ $\quad \varepsilon^2 = 0,259$

$\Omega_p = 1$ $\quad n = 4$

$$C_4 = 2w(4w^3 - 3w) - 2w^2 - 1$$

$$C_4 = 8w^4 - 6w^2 - 2w^2 - 1$$

$$C_4 = 8w^4 - 8w^2 - 1$$

$$|T(jw)|^2 = \frac{1}{1 + \varepsilon^2(8w^4 - 8w^2 - 1)^2}$$

$w = \frac{s}{j}$

$$= \frac{1}{1 + \varepsilon^2(8s^4 + 8s^2 - 1)^2} = \frac{1}{1 + \varepsilon^2(64s^8 + 64s^6 - 8s^4 + 64s^6 + 64s^4 - 8s^2 - 8s^4 - 8s^2 + 1)}$$

$$= \frac{1}{1 + \varepsilon^2(64s^8 + 128s^6 + 48s^4 - 16s^2 + 1)}$$

$$\frac{1}{as^4 + bs^3 + cs^2 + ds + e} \qquad \frac{1}{as^4 + bs^3 + cs^2 - ds + e}$$

NOTA

$$e = \sqrt{1+\xi^2}$$

De

$$\xi^2 64 = d^2 \longrightarrow \boxed{d = \xi 8}$$

$n=6$

$$\xi^2 128 = 2dc - b^2 \qquad b^2 = 2\xi 8c - \xi^2 128$$

$$b = \sqrt{2\xi 8c - \xi^2 128}$$

$n=4$

$$48\xi^2 = 2de - bd - bd + c^2$$

$n=2$

$$-16\xi^2 = 2ce - d^2 \rightarrow d = \sqrt{2\sqrt{(1+\xi^2)}c + 16\xi^2}$$

$$48\xi^2 = 2de - 2bd + c^2$$

$$48\xi^2 = 2\sqrt{2\sqrt{(1+\xi^2)} + 16\xi^2}\sqrt{(1+\xi^2)} - 2\sqrt{2\xi 8c - \xi^2 128}$$

Python:

$$T(s) = \frac{0{,}2456}{s^4 + 0{,}9528 s^3 + 1{,}4539 s^2 + 0{,}7426 s + 0{,}2756}$$

$$s = \frac{1}{\$}$$

$$T(\$) = \frac{0{,}2456}{\frac{1}{\$^4} + 0{,}9528\frac{1}{\$^3} + 1{,}4539\frac{1}{\$^2} + 0{,}7426\frac{1}{\$} + 0{,}2756}$$

$$T(\$) = \frac{\$^4\, 0{,}2456}{\$^4 0{,}2756 + \$^3 0{,}7426 + \$^2 1{,}4539 + \$ 0{,}9528 + 1}$$

$$T(\$) = \frac{0{,}891\ \$^4}{\$^4 + 2{,}6944\$^3 + 5{,}275\$^2 + 3{,}457\$ + 3{,}62}$$

$p_{1,2} = -0,143 \pm j0,996$

$R_{3,4} = -1,2 \pm j1,46$

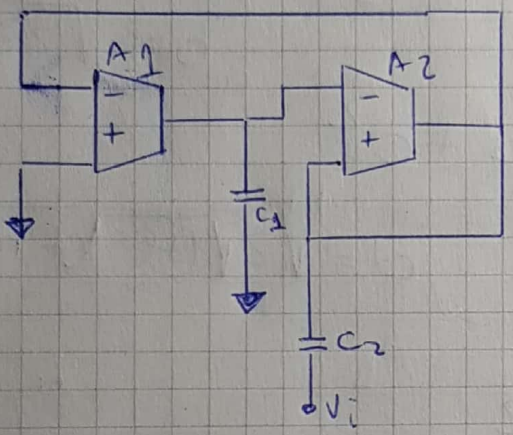
K

SOS 1

$$\frac{0,891 \quad s^2}{s^2 + 0,286s + 1,012}$$

SOS 2

$$\frac{s^2}{s^2 + 2,4s + 3,571}$$



$$\frac{s^2 C_1 C_2}{s^2 C_1 C_2 + s C_1 g_{m2} + g_{m1} g_{m2}}$$

$$\omega_0 = \frac{g_M}{\sqrt{C_1 C_2}} \qquad \sqrt{\frac{C_2}{C_1}} = Q$$

SOS ①

$C_1 g_{m2} = 0,286$

$g_{m1} g_{m2} = 1,012$

$C_1 C_2 = 1$

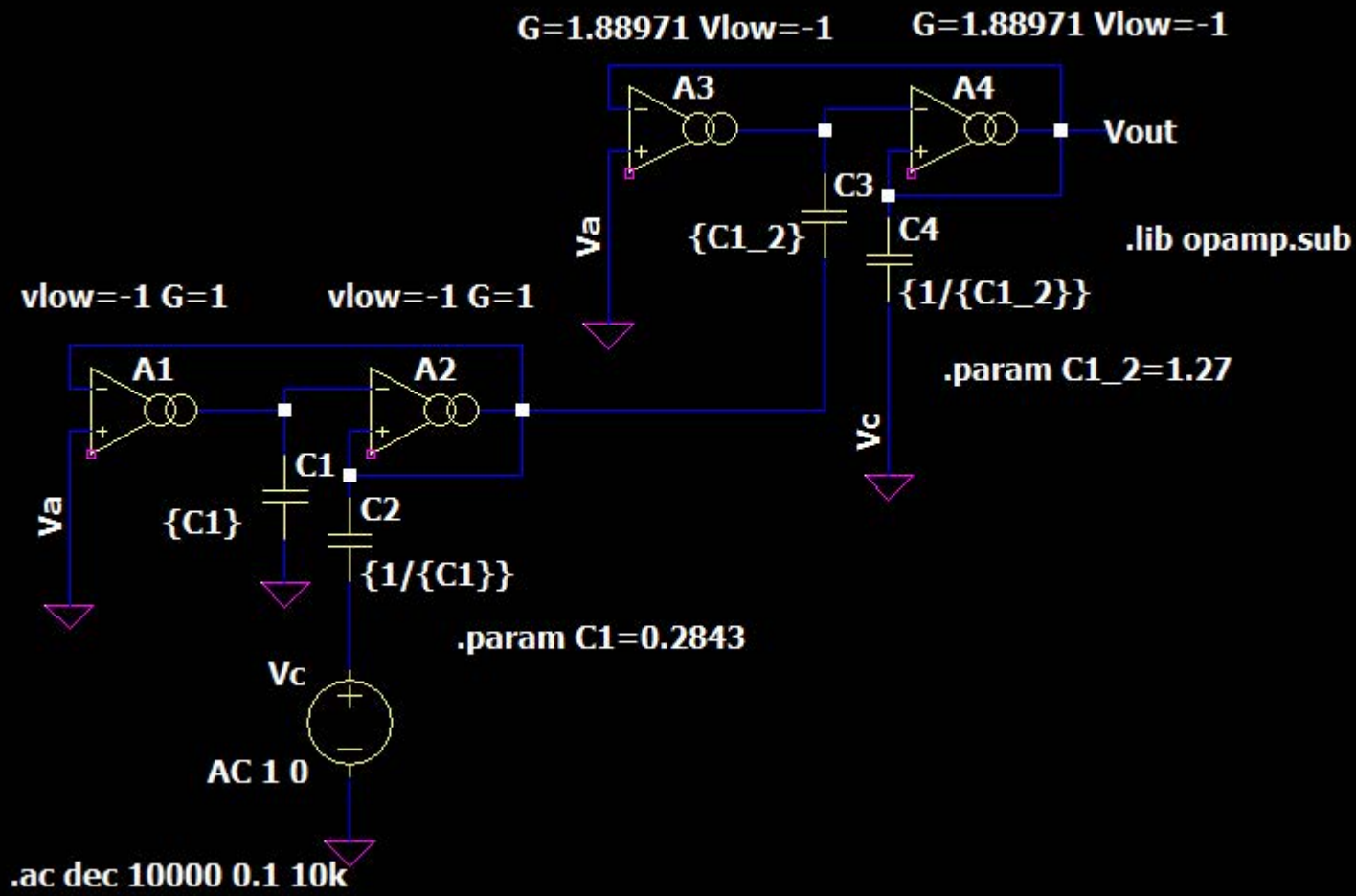
SOS ②

$C_1 g_{m2} = 2,4$

$g_{m1} g_{m2} = 3,571$

$C_1 C_2 = 1$

NOTA


G=1.88971 Vlow=-1
G=1.88971 Vlow=-1
A3
A4
Vout
C3
{C1_2}
C4
{1/{C1_2}}
.lib opamp.sub
Va
vlow=-1 G=1
vlow=-1 G=1
A1
A2
.param C1_2=1.27
Vc
C1
{C1}
C2
{1/{C1}}
Va
.param C1=0.2843
Vc
AC 1 0
.ac dec 10000 0.1 10k