clase 18/05/20

Ejercicio integrador

Pasa altos "máxima planicidad"

$\omega_p = 2\pi\, 300 \Rightarrow \omega_p = 1885 \Rightarrow \omega_{p\_n} = 1$

$\omega_{c\,ero} = 628,3 \quad \omega_{cero\_n} = 0,3333$

Pasa bajos

$\alpha_{max} = 3\,db$

$\alpha_{min} = 20\,db$

* Paso a plantilla de pasa bajos (tomado con gráfico)

- Aplico Transformación

$\omega_{Hp} = \dfrac{1}{\omega_{Lp}} \Rightarrow \omega_{p\_Lp} = 1$

$\omega_{cero\_Lp} = 3$

$\alpha_{max} = -20 \lg \left(1+\varepsilon^2 \underbrace{\omega_p^{2n}}_{=1}\right)^{-1/2}$

$\alpha_{max} = -10 \lg (1+\varepsilon^2)$

$10^{0,1\cdot\alpha_{max}} - 1 = \varepsilon^2 \Rightarrow \varepsilon = \sqrt{10^{0,1\alpha_{max}} - 1}$

$\varepsilon = 0,9976 \Rightarrow \varepsilon = 1$

* calculo el orden del denominador

atenuación = atenuación cero − Atenuación polo

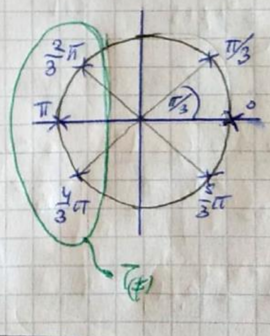
$-20\,db = 40\,db -$ Atenuación polo

atenuación polo $= -60\,db \Rightarrow$ El $\boxed{N=3}$ ya que atenuo 20 db por década.

$$|T(j\omega)|^2 = \frac{1}{1+\underbrace{\varepsilon^2}_{1} \omega^{2n}}\Bigg|_{\omega = \frac{s}{j}} = \frac{1}{1+\left(\frac{s}{j}\right)^6} = \frac{1}{1-s^6} \Rightarrow s = 1 \Rightarrow \theta_n = \frac{2k\pi}{6}$$

$\theta_0 = 0;\ \theta_1 = \dfrac{\pi}{3};\ \theta_2 = \dfrac{2}{3}\pi;\ \theta_3 = \pi;\ \theta_4 = \dfrac{4}{3}\pi;\ \theta_5 = \dfrac{5}{3}\pi;\ \cancel{\theta_6 = 2\pi}$

$Q = \dfrac{1}{2\cos\frac{\pi}{3}}$



* Obtengo la transferencia Pasa Bajos Normalizada

$$T(s) = \frac{1}{(s+1)(s^2+s+1)} = \frac{1}{s^3+\underbrace{s^2}+s+\underbrace{s^2}+s+1}$$

$$\boxed{T(s) = k_n \frac{1}{s^3+2s^2+2s+1}}$$

le agregamos el cero doble

$$\boxed{T(s) = \frac{K(s^2+9)}{s^3+2s^2+2s+1}}$$

$$\boxed{T(s) = \frac{k(s^2+9)}{s^3+2s^2+2s+1}}$$

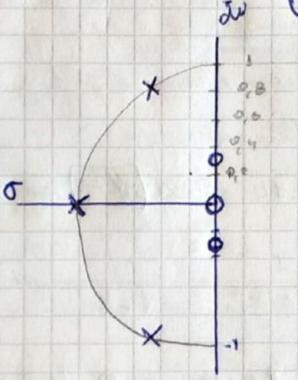
Aplico nucleo de Transformación $\left(s = \frac{1}{s}\right)$

$$T\left(\frac{1}{s}\right) = k \frac{\left(\frac{1}{s^2}+9\right)}{\frac{1}{s^3}+\frac{2}{s^2}+\frac{2}{s}+1} = \frac{s+s^3 9}{1+2s+2s^2+s^3} = \frac{s(1+s^2 9)}{s^3+2s^2+2s+1}$$

Transferencia para altos normalizada

$$\boxed{T(s) = \frac{(1+9s^2)s}{s^3+2s^2+2s+1}} \rightarrow a$$

b



$$T(s) = 9 \cdot \underbrace{\frac{\left(s^2+\frac{1}{9}\right)}{s^2+s+1}}_{1^\circ\ \text{Etapa}} \cdot \underbrace{\frac{s}{s+1}}_{2^\circ\ \text{Etapa}}$$

- Supongo "k=1"
- Supongo C=1

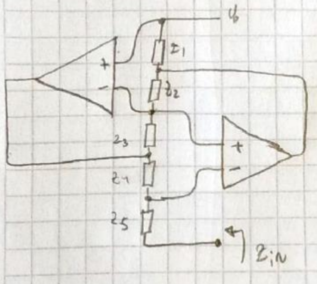
Despejo de la etapa 1° * Supongo C=1 * Supongo k=1 (Para eliminar la ganancia de la etapa).

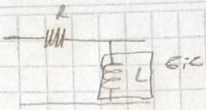
- $\frac{1}{R_2 R_3} = 1 \Rightarrow \boxed{R_3 = \frac{1}{R_2}}$ $\boxed{R_3 = \frac{9}{8}}$
- $\frac{1}{CR_1} = 1 \rightarrow \boxed{R_1 = 1}$

$$\frac{1}{R_2 R_3} - \frac{1}{R_3} = \frac{1}{9} \Rightarrow 1 - R_2 = \frac{1}{9} \Rightarrow R_2 = 1 - \frac{1}{9} \rightarrow \boxed{R_2 = \frac{8}{9}}$$

FECHA

2° Etapa: $\frac{s}{s+1}$





$$\frac{V_o}{V_i} = \frac{sL}{R+sL} = \frac{s}{s+\frac{R}{L}}$$

$$Z_{iN} = \frac{Z_1 \cdot Z_3 \cdot Z_5}{Z_2 \cdot Z_4}$$

$\boxed{Z_{iN} = 1\,Hy}$

$\frac{R}{L} = 1 \Rightarrow \boxed{L = 1H}$

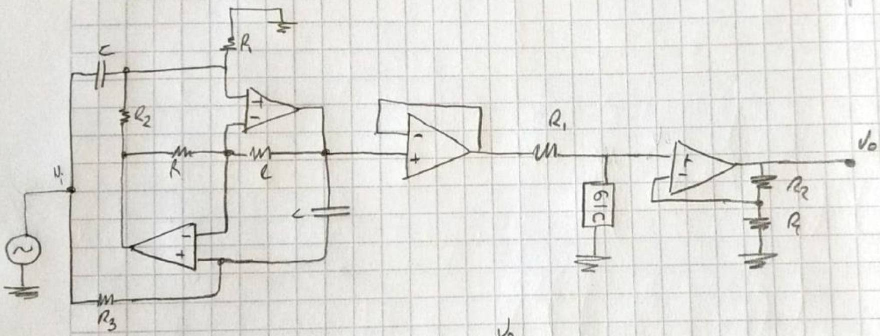
$Z_1 \cdot Z_3 \cdot Z_5 = 1\,\Omega$

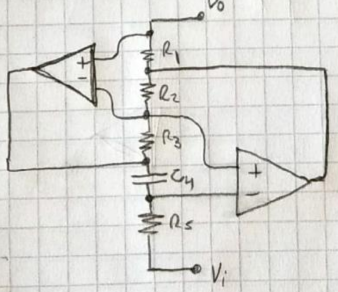
$Z_2 = 1\,\Omega$

$Z_4 = 1F = \frac{\Omega}{s}$

* Circuito completo *

$-25\,db = 20\,l_g\,dec$





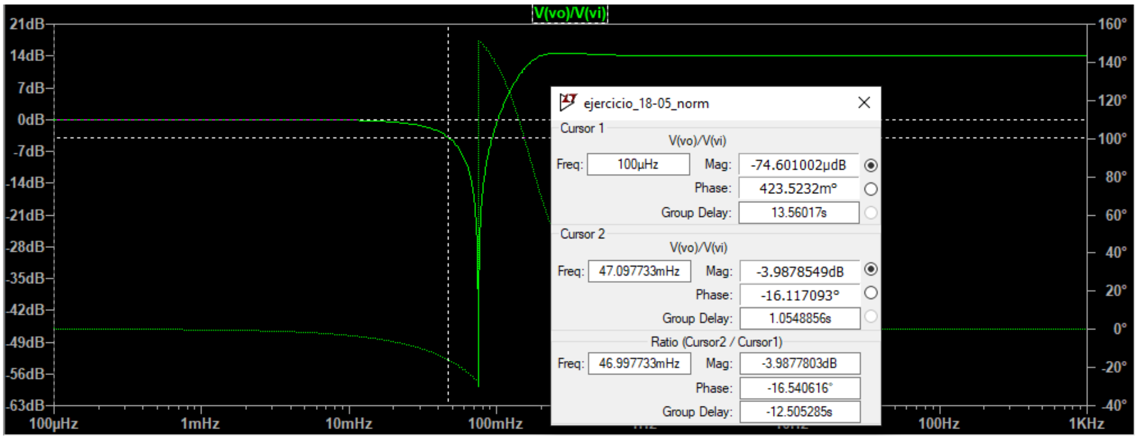
Etapa de ganancia

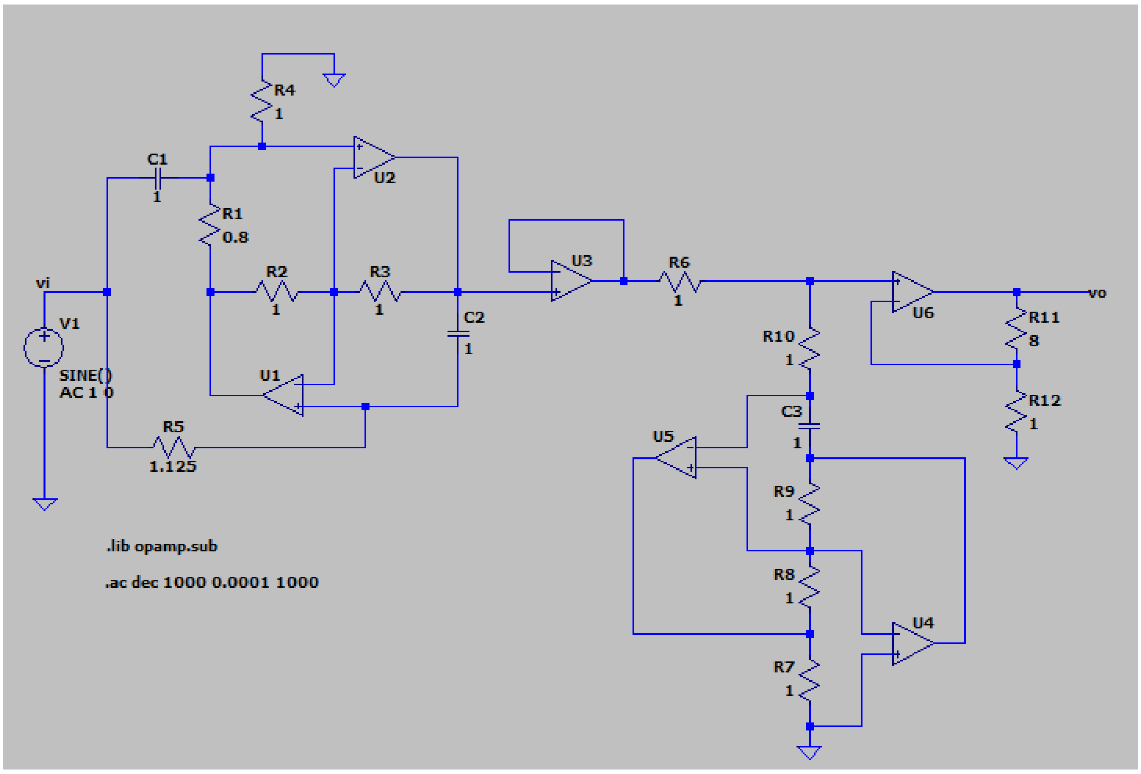
$\boxed{H(s) = 1 + \frac{R_2}{R_1}}$

$|K| = 9\,(\text{veces}) \Rightarrow 9 = 1 + \frac{R_2}{R_1} \Rightarrow \boxed{8R_1 = R_2}$

$\boxed{R_1 = 1\,\Omega}$

$\boxed{R_2 = 8\,\Omega}$


V(vo)/V(vi)
21dB
14dB
7dB
0dB
-7dB
-14dB
-21dB
-28dB
-35dB
-42dB
-49dB
-56dB
-63dB
160°
140°
120°
100°
80°
60°
40°
20°
0°
-20°
-40°
100µHz
1mHz
10mHz
100mHz
100Hz
1KHz
ejercicio_18-05_norm
Cursor 1
V(vo)/V(vi)
Freq: 100µHz
Mag: -74.601002µdB
Phase: 423.5232m°
Group Delay: 13.56017s
Cursor 2
V(vo)/V(vi)
Freq: 47.097733mHz
Mag: -3.9878549dB
Phase: -16.117093°
Group Delay: 1.0548856s
Ratio (Cursor2 / Cursor1)
Freq: 46.997733mHz
Mag: -3.9877803dB
Phase: -16.540616°
Group Delay: -12.505285s


R4
1
C1
1
U2
R1
0.8
vi
V1
R2
1
R3
1
C2
1
U1
SINE()
AC 1 0
R5
1.125
U3
R6
1
R10
1
U6
vo
R11
8
R12
1
C3
1
U5
R9
1
R8
1
U4
R7
1
.lib opamp.sub
.ac dec 1000 0.0001 1000