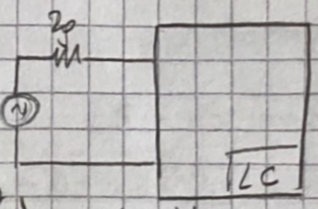
24/11/2022

* divisor res entre R_g y $1/Y_{11}$

1) $R_g = 1\,\Omega$ $\qquad Y(s) = \frac{k\cdot s}{s^3+3s^2+3s+1} = \frac{-I_2}{V_g}\Big|_{V_2=0}$

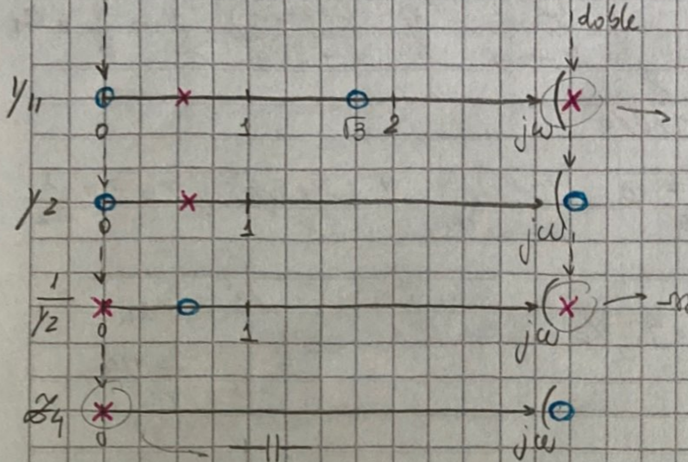


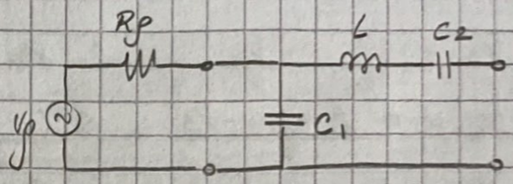
a) $Y(s) = \dfrac{\frac{ks}{3s^2+1}}{1+\frac{s^3+3s}{3s^2+1}}$

$I_2 = V_1 Y_{21} + V_2 Y_{22}$

$I_2 = Y_{21}\left(V_g \frac{1/Y_{11}}{1+1/Y_{11}}\right)$ * $\longrightarrow \frac{(-I_2)}{V_g}\Big|_{V_2=0} = -\frac{Y_{21}}{1+Y_{11}}$

$Y_{11} = \frac{s^3+3s}{3s^2+1} \qquad Y_{21} = \frac{s}{3s^2+1}$



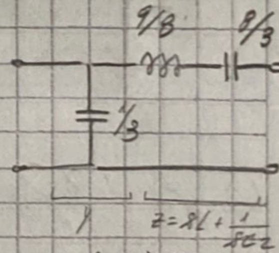


b) $Y_2 = Y_{11} - k_\infty s \qquad \lim_{s\to\infty} \frac{1}{s}\cdot\frac{s(s^2+3)}{3(s^2+1/3)} = \frac{1}{3} = C_1$

$Y_2 = \frac{s^3+3s-s^3-1/3\,s}{3(s^2+1/3)} = \frac{8}{9}\,\frac{s}{s^2+1/3}$

$Z_4 = \frac{1}{Y_2} - k'_\infty s \qquad \lim_{s\to\infty} \frac{1}{s}\,\frac{9}{8}\,\frac{(s^2+1/3)}{s} = \frac{9}{8} = L$

$Z_4 = \frac{9}{8}\,\frac{s^2+1/3-s^2}{s} = \frac{3}{8}\cdot\frac{1}{s} \longrightarrow C_2 = \frac{8}{3}$



c) $T = \begin{bmatrix}1 & R_g\\ 0 & 1\end{bmatrix}\cdot\begin{bmatrix}1 & 0\\ sC_1 & 1\end{bmatrix}\cdot\begin{bmatrix}1 & sL+1/sC_2\\ 0 & 1\end{bmatrix}$

$T = \begin{bmatrix}1+R_g sC_1 & R_g\\ - & -\end{bmatrix}\cdot\begin{bmatrix}1 & sL+1/sC_2\\ 0 & 1\end{bmatrix}$

$T \begin{cases} V_1 = AV_2 + (-I_2)B \\ I_1 = CV_2 + (-I_2)D \end{cases}$

$\frac{1}{B} = \frac{-I_2}{V_1}\Big|_{V_2=0}$

$B = (1+R_g sC_1)\left(sL + \frac{1}{sC_2}\right) + R_g \longrightarrow R_g = 1$

$B = (1+sC_1)\,\frac{s^2LC_2+1}{sC_2} + 1 = \frac{s^3C_1C_2L + s^2C_2L + sC_1 + 1}{sC_2} + 1$

$B = \frac{s^3C_1C_2L + s^2C_2L + s(C_1+C_2) + 1}{sC_2} = C_1L\,\frac{s^3 + s^2/C_1 + s\frac{C_1+C_2}{C_1C_2L} + \frac{1}{C_1C_2L}}{s}$

$\frac{1}{B} = \frac{1}{C_1L}\,\frac{s}{s^3+\frac{s^2}{C_1}+s\frac{C_1+C_2}{C_1C_2L}+\frac{1}{C_1C_2L}} = \frac{8}{3}\cdot\frac{s}{s^3+3s^2+3s+1} \quad \to k = -8/3$

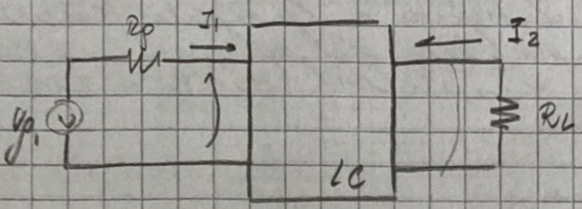
NOTA

HOJA Nº 6

FECHA

3) $R_L = 2R_g$ Butter 3er orden Ganancia transducción $= S_{21}$

$$H_{butter} = \frac{1}{s^3+2s^2+2s+1} \leftarrow S_{21}$$



$$S_{21} = \frac{V_2}{V_{g1}/2}\sqrt{\frac{R_g}{R_L}} = \frac{2V_2}{V_{g1}}\frac{\sqrt{2}}{2}$$

$$|S_{21}|^2 = \frac{1}{-s^6+1}$$

$$|S_{11}|^2 = 1-|S_{21}|^2 = \frac{s^6}{-s^6+1}$$

$$S_{11} = \frac{s^3}{s^3+2s^2+2s+1}$$

$$Z_1 = \frac{1+S_{11}(s)}{1-S_{11}(s)} \cdot R_{01} \qquad R_g = 1$$

$$Z_1 = \frac{s^3+2s^2+2s+1+s^3}{s^3+2s^2+2s+1-s^3} = \frac{2}{2}\,\frac{s^3+s^2+s+1/2}{s^2+s+1/2}$$

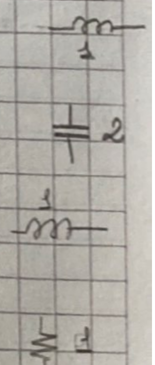
b) Sintetizo con Cauer

$$\begin{array}{l|l} s^3+s^2+s+1/2 & s^2+s+1/2 \\ -(s^3+s^2+s/2) & s \\ \hline s/2+1/2 & \end{array}$$

$$\begin{array}{l|l} s^2+s+1/2 & s/2+1/2 \\ -(s^2+s) & 2s \\ \hline 1/2 & \end{array}$$

$$\begin{array}{l|l} s/2+1/2 & 1/2 \\ -s/2 & s \\ \hline 1/2 & \end{array}$$

$$\begin{array}{l|l} 1/2 & 1/2 \\ -1/2 & 1 \\ \hline 0 & \end{array}$$



NOTA

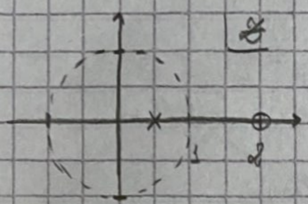
4) a) $A(z) = \frac{Y(z)}{X(z)}$ $\qquad y[n] = x[n-1] - x[n]k + y[n-1]k$

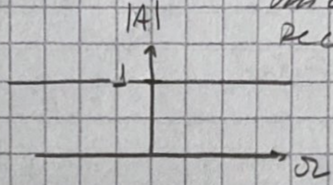
$$\frac{Y(z)}{X(z)} = \frac{z^{-1} - k}{1 - z^{-1}k} = \frac{1 - kz}{z - k}$$

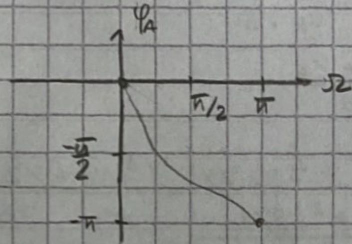
Para que sea estable $k \in \mathbb{R}$, y debe estar dentro de la circunferencia unitaria, es decir, $|k| < 1 \wedge k \in \mathbb{R}$
Es un pasa todo porque la distancia a la circunferencia unitaria del polo y el cero son recíprocas (simetría radial)

$$A(\Omega) = \frac{1 - k e^{j\Omega}}{e^{j\Omega} - k}$$

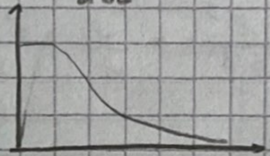
Asumo $k = 1/2$



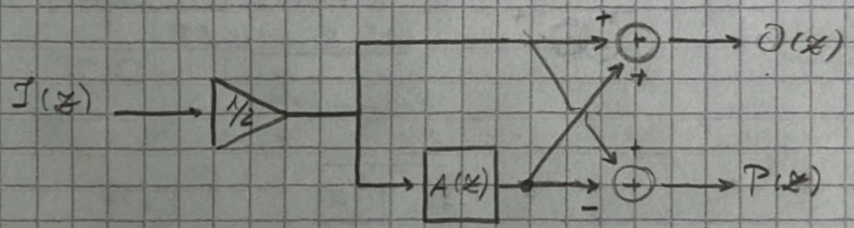




$\tau(\Omega) = -\frac{d\varphi_A}{d\Omega}$



b)

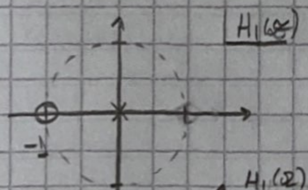


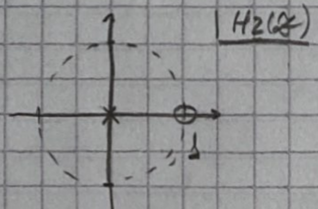
$O(z) = \frac{1}{2} I + \frac{1}{2} I\, A(z)$

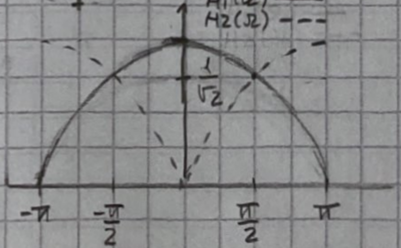
$\frac{z(1-k)}{z(1+k)}$

$$H_1(z) = \frac{O(z)}{I(z)} = \frac{1}{2}\left(1 + A(z)\right) = \frac{1}{2} \cdot \frac{z - k + 1 - kz}{z - k} = \frac{1}{2}\,\frac{(z+1)(1-k)}{z-k}$$

$$H_2(z) = \frac{P(z)}{I(z)} = \frac{1}{2}\,\frac{z - k + kz - 1}{z - k} = \frac{1}{2}\,\frac{(z-1)(1+k)}{z-k}$$







$|H_1(\Omega = \pi/2)| = H_1(\Omega = 0) \cdot \underbrace{0{,}707}_{-3\,dB}$

$$H_1(\Omega) = \frac{1}{2}\left(1 + \frac{1 - k e^{j\Omega}}{e^{j\Omega} - k}\right)$$

$$\frac{1}{2}\left|\left(1 + \frac{1 - ki}{i - k}\right)\right| = \frac{1}{\sqrt{2}} \cdot \frac{1}{2}\left(1 + \frac{1-k}{1-k}\right)$$

~~Iterando~~, $k = 0$

c) I) No es recursivo,* para el prewarping tendría que elegir la f más relevante
II) Es estable (polo en el origen), con las restricciones de k del punto a nunca podría dejar de ser estable

IV) A: 2 sumas $\qquad H_1$ y H_2: 3 sumas 2 multiplicaciones (contando $\frac{1}{2}$)

* no como un híbrido