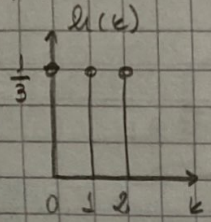
HOJA Nº 9

FECHA

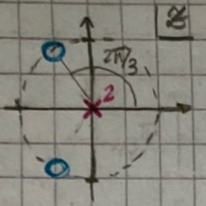
27/11/23

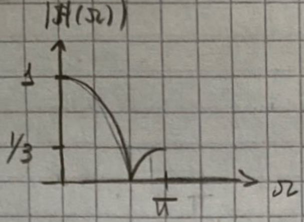
1)

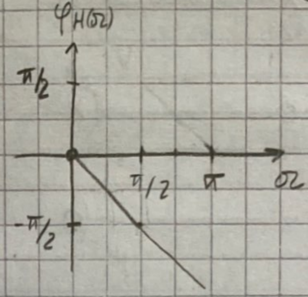


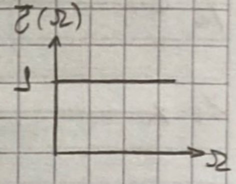
$h = \{1/3, 1/3, 1/3\}$ $\quad Y(z) = \frac{X(z)}{3}(1+z^{-1}+z^{-2})$

$H(z) = \frac{1}{3}\frac{z^2+z+1}{z^2}$ $\quad H(\Omega) = \frac{1}{3}(1+e^{-j\Omega}+e^{-2j\Omega})$









b) $H_2(z) = \frac{1}{D}\frac{1-z^{-D}}{1-z^{-1}}$ $\quad$ Para $D=3$: $H_2(z) = \frac{1}{3}\frac{z^3-1}{z^3-z^2} = \frac{z^2+z+1}{3z^2}$

↳ Para $D=3$ son equivalentes

Para $D=5$, H_1: $\frac{1}{5}(1+z^{-1}+z^{-2}+z^{-3}+z^{-4})$

4 sumas, 1 multiplicación (escala)

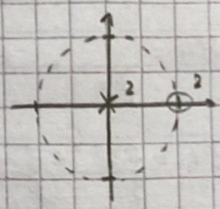
H_2 no varía su cantidad de cuentas con D. Para $D=5$, 2 sumas y 1 multiplicación (escala)

c) Para altos FIR 2do orden $\quad D=3$

$X(z)(z^{-R}-H(z)) = Y(z) \longrightarrow \frac{Y(z)}{X(z)} = z^{-R} - \frac{1}{3}\frac{z^2+z+1}{z^2}$

$\frac{Y(z)}{X(z)} = \frac{z^{2-R} - 1/3\, z^2 - 1/3\, z - 1/3}{z^2} = \frac{3z^{2-R} - z^2 - z - 1}{3z^2}$

Si $R=1$, $\frac{Y(z)}{X(z)} = \frac{-1}{3}\cdot\frac{z^2-2z+1}{z^2} = -\frac{1}{3}\frac{(z-1)^2}{z^2}$



2) $\Omega_z = 100\,\Omega$ $\quad \Omega_w = 100\,kHz$ $\quad$ Pasabanda no disipativo carga a la salida $\quad$ Butter 3er orden | no doble carga

↳ alternar + por abajo

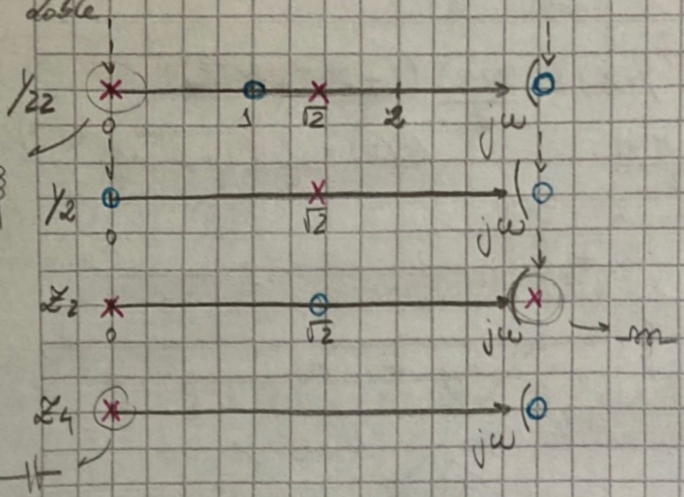
$T = \frac{I_2}{V_1}$ $\quad V_2 = -I_2 R_L$

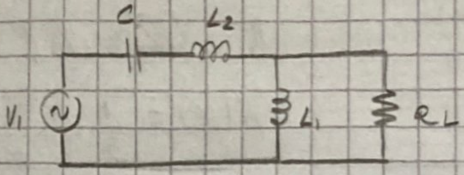
$I_2 = Y_{21}V_1 + Y_{22}V_2 \longrightarrow \frac{I_2}{V_1} = \frac{Y_{21}}{1+Y_{22}R_L} = \frac{Y_{21}}{1+Y_{22}}$ $\quad Z_z = R_L = 100\,\Omega$

$T = \frac{I_2}{V_1}\Big|_{V_2=(-I_2R_L)} = \frac{s^2}{s^3+2s^2+2s+1}$

NOTA

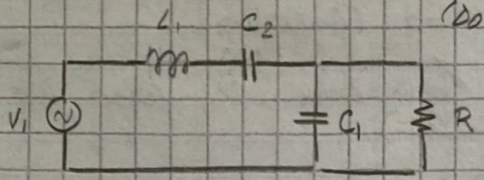
b) $T = \frac{Y_{21}}{1+Y_{22}} = \frac{s^2}{s^3+2s^2+2s+1}$ $\quad Y_{21} = \frac{s^2}{s^3+2s}$ $\quad Y_{22} = \frac{2s^2+1}{s^3+2s}$





c) $T = \frac{Y_{21}}{1+Y_{22}} = \frac{s}{s^3+2s^2+2s+1}$ $\quad Y_{21} = \frac{s}{2s^2+1}$ $\quad Y_{22} = \frac{s^3+2s}{2s^2+1}$

$Y_{22b)} = \left[Y_{22c)}\right]^{-1} \longrightarrow$ Donde tenía Y voy a tener Z ∴ los componentes quedan invertidos (donde tenía C tengo L)



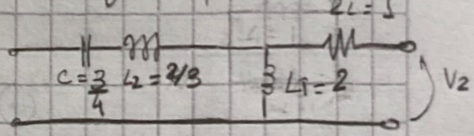
d) $Y_2 = Y_{22} - \frac{k_0}{s}$ $\qquad \lim_{s\to 0} s\,\frac{2s^2+1}{s^3+2s} = \frac{1}{2} \longrightarrow L_1 = 2$

$Y_2 = \frac{2s^2+1-s^2/2-1}{s^3+2s} = \frac{3}{2}\frac{s}{s^2+2}$

$Z_4 = \frac{1}{Y_2} - k_\infty s$ $\qquad \lim_{s\to\infty} \frac{1}{s}\,\frac{s^2+2}{s}\,\frac{2}{3} = \frac{2}{3} = L_2$

$Z_4 = \frac{2}{3}\,\frac{s^2+2-s^2}{s} = \frac{4}{3}\frac{1}{s}$ $\qquad C_1 = \frac{3}{4}$

e) Para poder verificar con parámetros T tengo que poner R en serie $B = V_1/(-I_2)\,|_{V_2=0}$



$$T = \begin{bmatrix} 1 & \frac{1}{sC_1} + sL_2 \\ 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 \\ \frac{1}{sL_1} & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & R_L \\ 0 & 1 \end{bmatrix}$$

$$T = \begin{bmatrix} 1 + \frac{1}{sL_1}\left(\frac{1}{sC_1} + sL_2\right) & \frac{1}{sC_1} + sL_2 \\ — & — \end{bmatrix} \cdot \begin{bmatrix} 1 & R_L \\ 0 & 1 \end{bmatrix}$$

$$B = R_L\left(1 + \frac{s^2L_2C_1+1}{s^2L_1C_1}\right) + \frac{s^2L_2C_1+1}{sC_1} = \frac{s^2C_1(L_1+L_2)+1+s^3L_1L_2C_1+sL_1}{s^2L_1C_1}$$

HOJA Nº 10

FECHA

$$\frac{A}{B} = T(s) = \frac{s^2 L_1 C_1}{s^3 L_1 L_2 C_1 + s^2(L_1+L_2)C_1 + sL_1 + 1} = \frac{1}{L_2}\,\frac{s^2}{s^3 + s^2\frac{L_1+L_2}{L_1L_2} + \frac{s}{L_2C} + \frac{1}{L_1L_2C}}$$

$$T(s) = 2\,\frac{s^2}{s^3+2s^2+2s+1} \quad \checkmark \quad k = 2$$

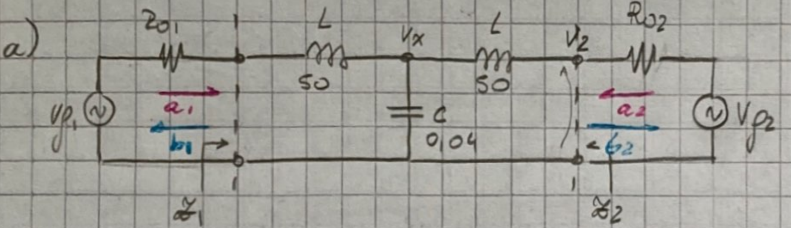
No se podría verificar con MAI por la condición de medición.

f) $C^0 = \frac{3}{4}\cdot\frac{1}{\Omega_Z\,\Omega_W} = 75u\,F$ $\qquad L_1^0 = 2\,\frac{\Omega_Z}{\Omega_W} = 2m\,Hy$

$L_2^0 = \frac{2}{3}\,\frac{\Omega_Z}{\Omega_W} = 666\,\mu Hy$

3) $R_{01} = R_{02} = 50\Omega$

a)



$S_{11} = \frac{b_1}{a_1}\Big|_{a_2=0}$ coeficiente de reflexión puerto 1

$S_{11} = \frac{Z_1 - R_{01}}{Z_1 + R_{01}}$

$S_{22} = \frac{b_2}{a_2}\Big|_{a_1=0} = \frac{Z_2 - R_{02}}{Z_2 + R_{02}}$ coef de reflexión del puerto 2

$S_{12} = \frac{b_1}{a_2}\Big|_{a_1=0} = \frac{V_1}{V_{g2}/2}\sqrt{\frac{R_{02}}{R_{01}}}$ coef de transferencia inversa

$S_{21} = \frac{b_2}{a_1}\Big|_{a_2=0} = \frac{V_2}{V_{g1}/2}\sqrt{\frac{R_{01}}{R_{02}}}$ coef de transferencia directa

b) Busco S_{21} para analizar la transferencia

$V_2 = R_{02}\cdot I_2 \qquad I_2 = \frac{V_x - V_2}{sL} \qquad I_1 = \frac{V_{g1} - V_x}{R_{01} + sL} \qquad I_1 = I_2 + V_x sC$

$I_2 + V_x sC = \frac{V_{g1} - V_x}{R_{01} + sL} \longrightarrow I_2 sL + V_2 = V_x$

$I_2 + (I_2 sL + V_2)sC = \frac{V_{g1}}{R_{01}+sL} - \frac{I_2 sL + V_2}{R_{01}+sL} \qquad I_2 = V_2 / R_{02}$

$$V_2\left(\frac{1}{R_{02}} + \frac{s^2CL}{R_{02}} + sC + \frac{sL}{R_{02}(R_{01}+sL)} + \frac{1}{R_{01}+sL}\right) = \frac{V_{g1}}{R_{01}+sL}$$

$$V_2\left(\frac{R_0 + sL + s^3CL^2 + s^2CLR_0 + s^2LR_0C + sCR^2 + sL + R_0}{R_0\cancel{(R_0+sL)}}\right) = \frac{V_{g1}}{\cancel{R_{01}+sL}}$$

$$\frac{V_2}{V_{g1}} = \frac{R_0}{s^3CL^2 + s^2 2(LR_0C) + s(CR_0^2 + 2L) + 2R_0} = \frac{1}{2}\,\frac{1}{s^3 + 2s^2 + 2s + 1}$$

NOTA

$$S_{21} = 2\frac{V_2}{V_{g1}}\sqrt{\frac{R_{01}}{R_{02}}} = \frac{1}{s^3+2s^2+2s+1} \longrightarrow \text{paso bajos butter } 3^{er} \text{ orden}$$

$\rightarrow \omega_0^2, \; \omega_0 = 1 \rightarrow f_0 = 0{,}160\ Hz$

$$S_{22} = \frac{Z_2 - R_{02}}{Z_2 + R_{02}} \qquad Z_2 = \left[(R_{01} + sL) \,//\, \left(\frac{1}{sC}\right)\right] + sL$$

$$Z_2 = \frac{1}{sC + \frac{1}{R_0 + sL}} + sL = \frac{R_0 + sL}{s^2CL + sCR_0 + 1} + sL = \frac{sL + R_0 + s^3CL^2 + s^2LCR_0 + sL}{s^2CL + sCR_0 + 1}$$

$$Z_2 = \frac{s^3CL^2 + s^2LCR_0 + s2L + R_0}{s^2CL + sCR_0 + 1} \qquad \lim_{s\to 0} Z_2 = R_0 = 50\Omega$$

$\rightarrow$ continua

$$S_{22}\Big|_{s=0} = 0 \longrightarrow \text{está adaptado}$$

$S_{11} = S_{22} \longrightarrow$ Red simétrica

$S_{12} = S_{21} \longrightarrow$ Red recíproca y pasiva

NOTA