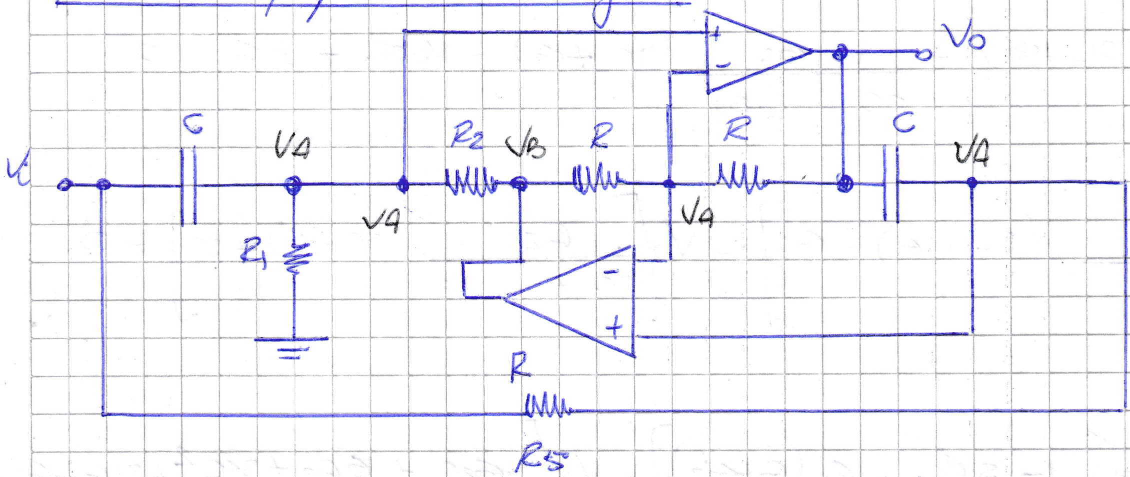
Punto (1)(c) : Síntesis del filtro.

La estructura propuesta es la siguiente:



Planteamos las ecuaciones con los nodos:

I) $V_A \cdot (sC + G_1 + G_2) - V_i\, sC - V_B\, G_2 = 0$

II) $V_A \cdot (G + G) - V_B (G) - V_o (G) = 0$

III) $V_A (sC + G) - V_o sC - V_i (G) = 0$

De la ecuación (II) despejamos V_B:

$$V_B = 2 \cdot V_A - V_o \quad (IV)$$

Ahora reemplazamos la ecuación (IV) en (I):

$$V_A \cdot (sC + G_1 + G_2) - V_i\, sC - (2 V_A - V_o) G_2 = 0$$

$$V_A \cdot (sC + G_1 + G_2) - V_i\, sC - V_A\, 2G_2 + V_o\, G_2 = 0$$

$$V_A \cdot (sC + G_1 - G_2) - V_i\, sC + V_o\, G_2 = 0$$

$$V_A = \frac{sC\, V_i - G_2 V_o}{sC + G_1 - G_2} \quad (V)$$

Reemplazamos la ecuación (V) en (III):

$$\frac{V_i sC - V_o G_2}{sC + G_1 - G_2} \cdot (sC + G) - V_o sC - V_i G = 0$$

$$\frac{V_i sC}{sC + G_1 - G_2} \cdot (sC + G) - \frac{V_o G_2}{sC + G_1 - G_2}(sC + G) - V_o sC + V_i G = 0$$

$$V_i\left[\frac{sC}{sC + G_1 - G_2} \cdot (sC + G) - G\right] - V_o\left[\frac{G_2}{sC + G_1 - G_2}(sC + G) + sC\right] = 0$$

$$V_i\left[\frac{s^2C^2 + \cancel{sGC} - \cancel{sGC} - G\cdot(G_1 - G_2)}{sC + G_1 - G_2}\right] = V_o\left[\frac{sG_2C + GG_2 + s^2C^2 + s(G_1 - G_2)\cdot C}{sC + G_1 - G_2}\right]$$

$$V_i\left(s^2C^2 - G\cdot(G_1 - G_2)\right) = V_o\cdot\left(GG_2 + s^2C^2 + sG_1C\right)$$

$$T(s) = \frac{V_o}{V_i} = \frac{s^2C^2 - G(G_1 - G_2)}{s^2C^2 + sG_1C + GG_2}$$

$$T(s) = \frac{\cancel{C^2}}{\cancel{C^2}} \cdot \frac{s^2 - \frac{G(G_1 - G_2)}{C^2}}{s^2 + s\frac{G_1\cancel{C}}{C^2} + \frac{G\cdot G_2}{C^2}}$$

$$\boxed{T(s) = \frac{s^2 + \frac{G\cdot(G_2 - G_1)}{C^2}}{s^2 + s\frac{G_1}{C} + \frac{GG_2}{C^2}}}$$

Transferencia de la estructura propuesta.

Ahora, la comparamos con la etapa de segundo orden del filtro pasa altos obtenido anteriormente:

$$\frac{s^2 + 1/9}{s^2 + \sqrt{2}s + 1}$$

Entonces:

$$\frac{G \cdot (G_2 - G_1)}{C^2} = \frac{1}{9} \quad \wedge \quad \frac{G_1}{C} = \sqrt{2} \quad \wedge \quad \frac{G G_2}{C^2} = 1$$

Propongo y asumo $\boxed{C = 1}$:

$$\boxed{G_1 = \sqrt{2}}$$

$$G = \frac{1}{G_2} \quad \wedge \quad G \cdot (G_2 - G_1) = \frac{1}{9}$$

$$\frac{1}{G_2} \cdot (G_2 - G_1) = \frac{1}{9} \Rightarrow 1 - \frac{G_1}{G_2} = \frac{1}{9} \Rightarrow 1 - \frac{\sqrt{2}}{G_2} = \frac{1}{9}$$

$$\frac{\sqrt{2}}{G_2} = 1 - \frac{1}{9} \Rightarrow G_2 = \frac{\sqrt{2}}{1 - 1/9} \Rightarrow \boxed{G_2 \simeq 1,59}$$

$$G = \frac{1}{1,59} \Rightarrow \boxed{G \simeq 0,6289}$$

$$\boxed{\begin{array}{ll} C = 1 & R_1 = 1/G_1 = 0,707 \\ R = 1/G = 1,59 & R_2 = 1/G_2 = 0,6289 \end{array}}$$

Valores de componentes normalizados para etapa de segundo orden.

Ahora, para la primer etapa, que es de primer orden tenemos:

$\boxed{R_3 = 1}$ $\wedge$ $\boxed{C = 1}$

Desarrollando los componentes:

$$\boxed{\Omega_Z = 1000}$$

$$\boxed{\Omega_W = 2\pi\, 300}$$

$$C = \frac{C'}{\Omega_W \cdot \Omega_Z} = \frac{1}{1000 \cdot 2\pi\, 300} \approx 530,52\ nF$$

$$R = R' \cdot \Omega_Z = 1,59 \cdot 1000 = 1590\ \Omega$$

$$R_1 = R_1' \cdot \Omega_Z = 0,707 \cdot 1000 = 707,1\ \Omega$$

$$R_2 = R_2' \cdot \Omega_Z = 0,6288 \cdot 1000 = 628,8\ \Omega$$

$$R_3 = R_3' \cdot \Omega_Z = 1 \cdot 1000 = 1000\ \Omega$$