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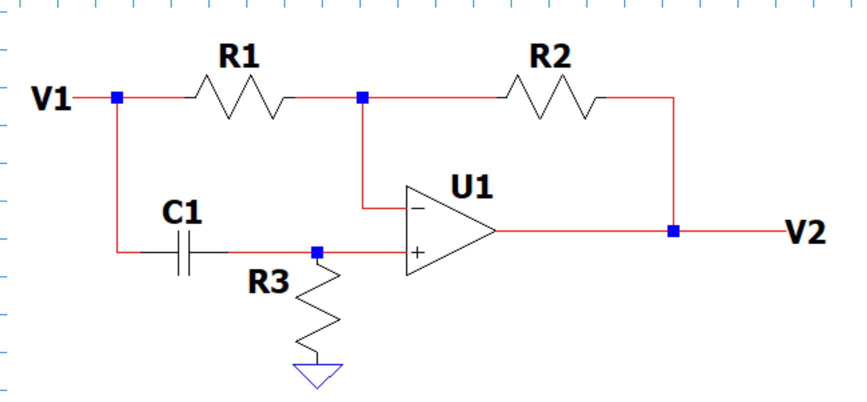
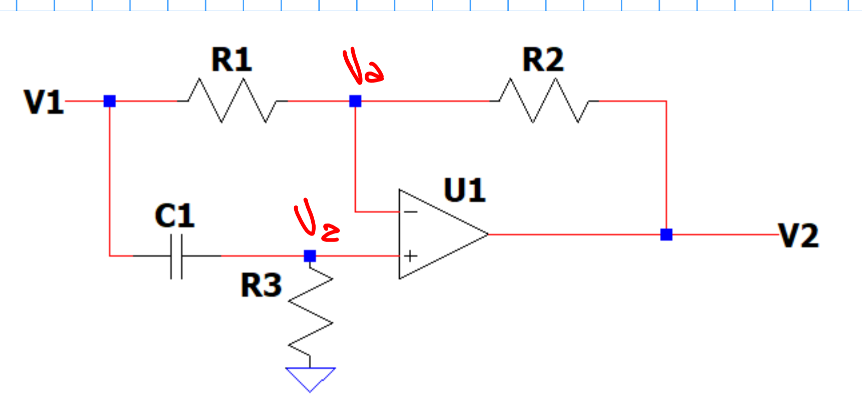
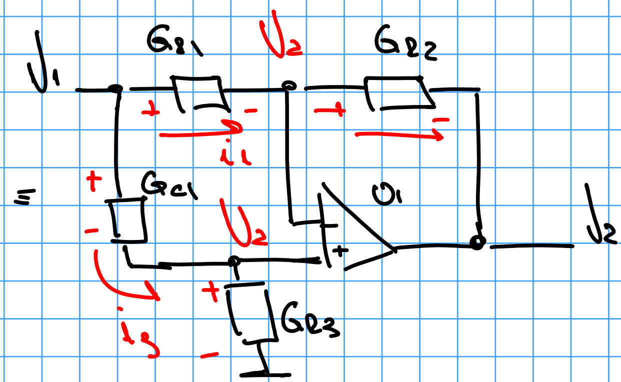
Trabajo semanal 1:



1. Obtener la función transferencia V2/V1 (módulo, fase y diagrama de polos y ceros).





. Método de Nodos

$$V_a(G_{R1}+G_{R2}) - V_1 G_{R1} - V_2 . G_{R2} = 0$$

$$V_a(G_{C1}+G_{C3}) - V_1 G_{C1} = 0 \longrightarrow V_a = V_1 \frac{G_{C1}}{G_{C1}+G_{C3}}$$

$$V_1 \frac{G_{C1}}{G_{C1}+G_{R3}}(G_{R1}+G_{R2}) - V_1 G_{R1} - V_2 . G_{R2} = 0$$

$$V_1\left[\frac{G_{C1}(G_{R1}+G_{R2})}{G_{C1}+G_{R3}} - G_{R1}\right] = V_2 . G_{R2}$$

$$V_1\left[\frac{G_{C1}(G_{R1}+G_{R2}) - G_{R1}(G_{C1}+G_{R3})}{G_{C1}+G_{R3}}\right] = V_2 . G_{R2}$$

$$V_1\left[G_{C1}(G_{R1}+G_{R2}) - G_{R1}(G_{C1}+G_{R3})\right] = V_2 . G_{R2}(G_{C1}+G_{R3})$$

$$\frac{V_2}{V_1} = \frac{G_{C1}(G_{R1}+G_{R2}) - G_{R1}(G_{C1}+G_{R3})}{G_{R2}(G_{C1}+G_{R3})}$$

- $G_{R1} = 1/R_1$ · $G_{C1} = sC_1$
- $G_{R2} = 1/R_2$
- $G_{R3} = 1/R_3$

$$\cdot \ \frac{V_2}{V_1} = \frac{sC_1\left(1/R_1 + 1/R_2\right) - 1/R_1\left(sC_1 + 1/R_3\right)}{1/R_2\left(sC_1 + 1/R_3\right)}$$

$$\cdot \ \frac{V_2}{V_1} = \frac{sC_1\left(\frac{R_1+R_2}{R_1R_2}\right) - \frac{sC_1}{R_1} - \frac{1}{R_3R_1}}{sC_1/R_2 + \frac{1}{R_3R_2}}$$

$$\cdot \ \frac{V_2}{V_1} = \frac{sC_1\left(\frac{R_1+R_2}{R_1R_2} - \frac{1}{R_1}\right) \quad 1/R_3R_1}{sC_1/R_2 + 1/R_3R_2}$$

$$\frac{R_1^2 + R_1R_2 - R_1R_2}{R_1^2R_2}$$

$$\frac{R_1^2}{R_1^2R_2} = \frac{1}{R_2}$$

$$\cdot \ \frac{V_2}{V_1} = \frac{sC_1\left(\frac{\cancel{R_1}^2 + \cancel{R_1R_2} - \cancel{R_1R_2}}{\cancel{R_1}^2R_2}\right) - 1/R_3R_1}{sC_1/R_2 + 1/R_3R_2}$$

$$\cdot \ \frac{V_2}{V_1} = \frac{sC_1/R_2 + 1/R_3R_1}{sC_1/R_2 + 1/R_3R_2} = \frac{C_1}{R_2}\cdot\frac{R_2}{C_1}\cdot\frac{s - \frac{R_2}{C_1R_3R_1}}{s + \frac{R_2}{C_1}\cdot\frac{1}{R_3R_2}}$$

$$- \ \frac{V_2}{V_1} = \frac{s - \frac{1}{C_1R_3}\,R_2/R_1}{s + \frac{1}{C_1R_3}} = T(s)$$

Modulo

$$T(j\omega) = \frac{j\omega - 1/C_1R_3\ R_2/R_1}{j\omega + \frac{1}{C_1R_3}\ R_2/R_1}$$

$$|T(j\omega)| = \left|\frac{j\omega - 1/C_1R_3\ R_2/R_1}{j\omega + 1/C_1R_3}\right| = \frac{|j\omega - 1/C_1R_3\ R_2/R_1|}{|j\omega - 1/C_1R_3\ R_2/R_1|}$$

$$|T(j\omega)| = \frac{\sqrt{\left(-1/C_1R_3\ R_2/R_1\right)^2 + (j\omega)^2}}{\sqrt{\left(1/C_1R_3\right)^2 + (j\omega)^2}} = \frac{\sqrt{\left(-1/C_1R_3\ R_2/R_1\right)^2 - \omega^2}}{\sqrt{\left(-\frac{1}{C_1R_3}\frac{R_2}{R_1}\right)^2 - \omega^2}}$$

$$\log|T(j\omega)| = \log\left(\frac{\sqrt{\left(-\frac{1}{C_1R_3}\cdot\frac{R_2}{R_1}\right)^2-\omega^2}}{\sqrt{\frac{1}{C_1R_3}+\omega^2}}\right)$$

$$\log|T(j\omega)| = \log\left(\sqrt{\left(-\frac{1}{C_1R_3}\cdot\frac{R_2}{R_1}\right)^2-\omega^2}\right) - \log\left(\sqrt{\left(\frac{1}{C_1R_3}\right)^2-\omega^2}\right)$$

$$\log|T(j\omega)| = \frac{1}{2}\log\left[\left(-\frac{1}{C_1R_3}\cdot\frac{R_2}{R_1}\right)^2-\omega^2\right] - \frac{1}{2}\log\left[\left(\frac{1}{C_3R_3}\right)^2-\omega^2\right]$$

en $\omega = 0$

$$\log|T(j0)| = \frac{1}{2}\log\left(-\frac{1}{C_1R_3}\cdot\frac{R_2}{R_1}\right)^2 - \frac{1}{2}\log\left(\frac{1}{C_3R_3}\right)^2$$

$$\log|T(j0)| = \cancel{\frac{1}{2}\log\left(-\frac{1}{C_1R_3}\right)^2} + \frac{1}{2}\log\left(\frac{R_2}{R_1}\right)^2 - \cancel{\frac{1}{2}\log\left(\frac{1}{C_1R_3}\right)^2} = \boxed{\log\frac{R_2}{R_1}}$$

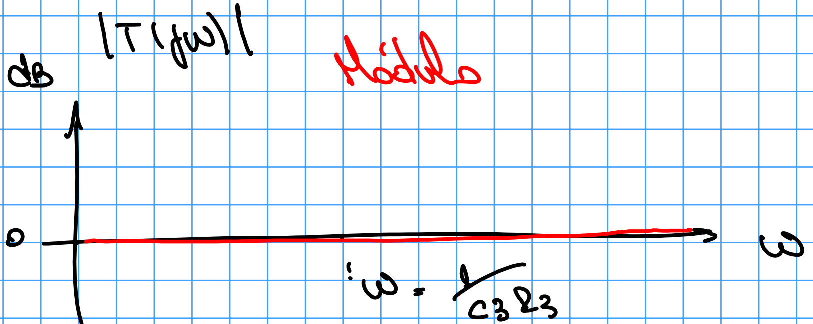
en $\omega = 0$

$$\log|T(j\infty)| = \frac{1}{2}\log\left[\frac{\left(-\frac{1}{C_1R_3}\cdot\frac{R_2}{R_1}\right)^2-\omega^2}{\left(\frac{1}{C_1R_3}\right)^2-\omega^2}\right] = \frac{1}{2}\log\left[\frac{\left(-\frac{1}{C_1R_3\omega}\frac{R_2}{R_1}\right)^2-1}{\left(\frac{1}{C_1R_3\omega}\right)^2-1}\right]$$

$$\log|T(j\infty)| = \frac{1}{2}\log\left(-\frac{1}{-1}\right) = \frac{1}{2}\log 1 = \boxed{0}$$

Módulo

para $R_2 = R_1 \Rightarrow \frac{R_2}{R_1} = 1$



fase

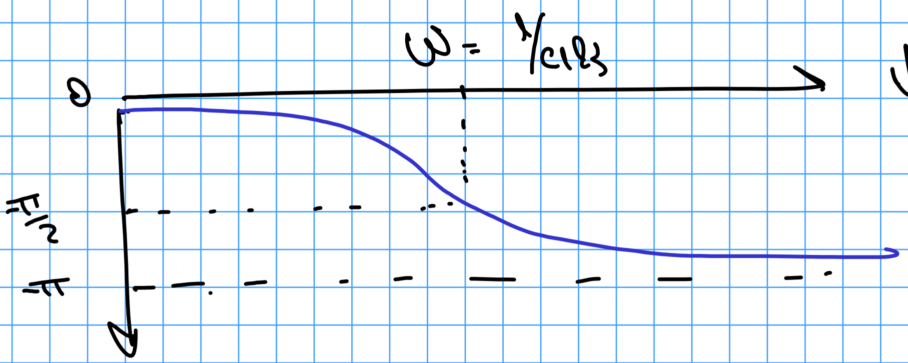
$$\varphi(j\omega) = \varphi_f - \varphi_s = Tg^{-1}\left[\frac{\omega}{\left(-\frac{1}{C_1R_3}\cdot\frac{R_2}{R_1}\right)}\right] - Tg^{-1}\left[\frac{\omega}{\left(\frac{1}{C_1R_3}\right)}\right]$$

$\omega = 0$

$$\varphi(j0) = Tg^{-1}(0) - Tg^{-1}(0) = 0$$

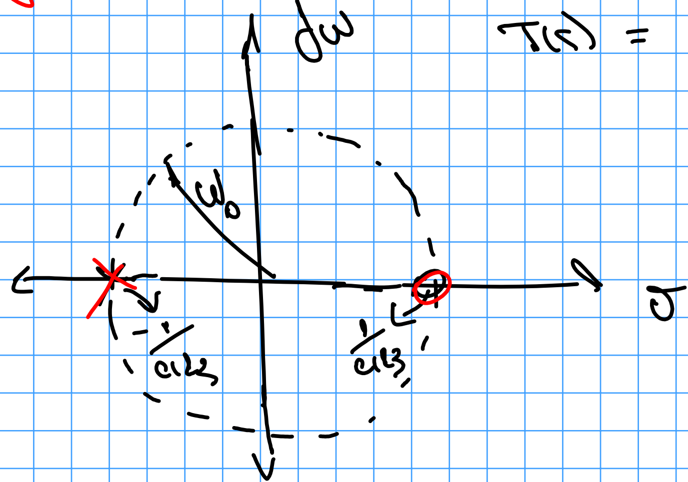
$$\varphi(j\infty) = Tg^{-1}(-\infty) - Tg^{-1}(\infty) = -\frac{\pi}{2} - \frac{\pi}{2} = -\pi$$

$\frac{R_2}{R_1} = 1$



fase

Diagrama polos y ceros



$$T(s) = \frac{s - 1/C_1R_3}{s + 1/C_1R_3} \; ; \; \frac{R_2}{R_1} = 1$$