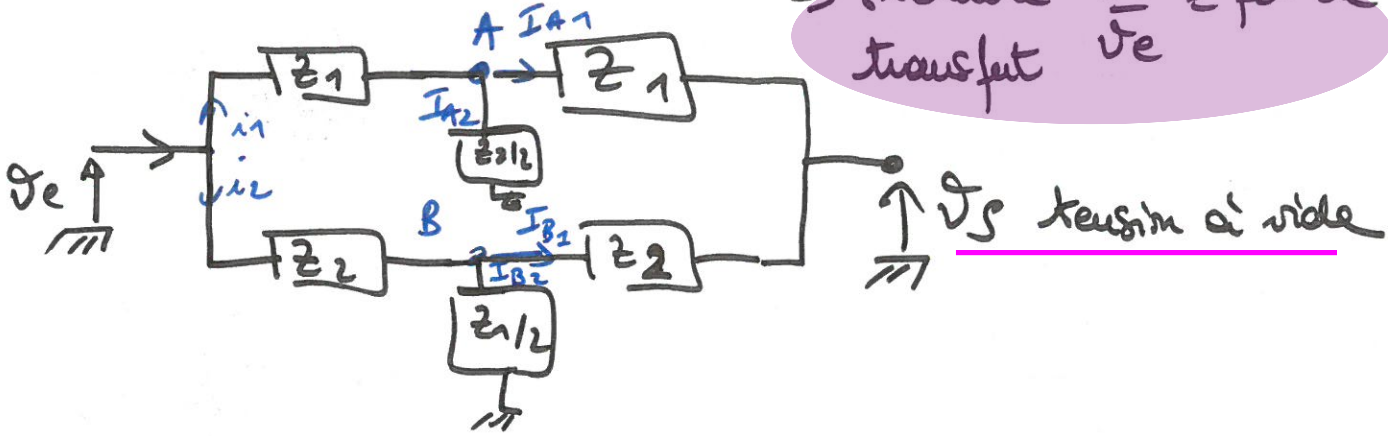
Exo 5 Double T en pont.

$\Rightarrow$ recherche $\frac{v_s}{v_e}$ = fct de transfert



* $v_e - Z_1 i_1 = v_A$

$v_A - \frac{Z_2}{2} I_{A2} = 0$

$v_A - Z_1 I_{A1} = v_S$

$I_1 = I_{A2} + I_{A1}$

$\Rightarrow \frac{v_e - v_A}{Z_1} = 2\frac{v_A}{Z_2} + \frac{v_A - v_S}{Z_1}$

$\Rightarrow v_e - v_A = 2 v_A \frac{Z_1}{Z_2} + v_A - v_S$

$\Rightarrow v_e + v_S = 2 v_A \left(\frac{Z_1}{Z_2} + 1\right) = 2 v_A \frac{Z_1 + Z_2}{Z_2}$

$\Rightarrow v_A = \frac{v_e + v_s}{2} \frac{Z_2}{Z_1 + Z_2}$ (A)

par symétrie $A \rightarrow B$, $Z_1 \rightarrow Z_2$ $\quad v_B = \frac{v_e + v_s}{2} \frac{Z_1}{Z_1 + Z_2}$ (B)

* $I_{A1} + I_{B1} = 0$ fil non relié

$\frac{v_A - v_S}{Z_1} + \frac{v_B - v_S}{Z_2} = 0 \Rightarrow \frac{v_A}{Z_1} + \frac{v_B}{Z_2} = v_s \frac{Z_1 + Z_2}{Z_1 Z_2}$

$\Rightarrow v_S = \frac{Z_1 Z_2}{Z_1 + Z_2}\left[\frac{v_A}{Z_1} + \frac{v_B}{Z_2}\right] = v_A \frac{Z_2}{Z_1 + Z_2} + v_B \frac{Z_1}{Z_1 + Z_2}$

$\Rightarrow v_s = \left(\frac{Z_2}{Z_1 + Z_2}\right)^2 \frac{v_e + v_s}{2} + \left(\frac{Z_1}{Z_1 + Z_2}\right)^2 \frac{v_e + v_s}{2}$

$v_s = \frac{v_e + v_s}{2}\left[\frac{Z_2^2 + Z_1^2}{(Z_1 + Z_2)^2}\right] \Rightarrow \frac{v_e + v_s}{v_s} = 2\frac{(Z_1 + Z_2)^2}{Z_1^2 + Z_2^2}$

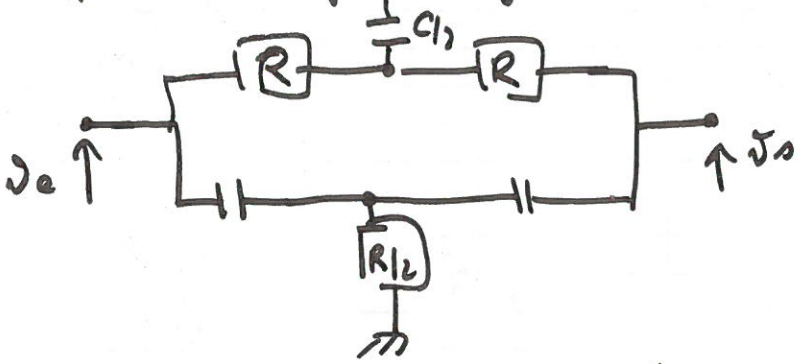
$$\frac{v_e}{v_0}+1 = 2\,\frac{(z_1+z_2)^2}{z_1^2+z_2^2} \Rightarrow \frac{v_e}{v_0} = \frac{2(z_1+z_2)^2}{z_1^2+z_2^2} - 1$$

$$\frac{v_e}{v_0} = \frac{2z_1^2+2z_2^2+4z_1z_2 - z_1^2 - z_2^2}{z_1^2+z_2^2} = \frac{(z_1+z_2)^2+2z_1z_2}{z_1^2+z_2^2}$$

$$= \frac{z_1^2+z_2^2+4z_1z_2}{z_1^2+z_2^2}$$

$$\frac{v_0}{v_e} = \frac{(z_1^2+z_2^2)}{z_1^2+z_2^2+4z_1z_2} = \frac{1}{1+4\,\frac{z_1z_2}{z_1^2+z_2^2}}$$ fct° de transfert

applicat° au filtre rejecteur



$z_1 = R$

$z_2 = \frac{1}{jC\omega}$

$\tau = RC$

$$\frac{v_0}{v_e} = \frac{1}{1+4\,\frac{R/jC\omega}{R^2-1/C^2\omega^2}} = \frac{1}{1+\frac{4RC\omega}{jC^2\omega^2R^2-\frac{jC^2\omega^2}{C^2\omega^2}}}$$

$$\frac{v_0}{v_e} = \frac{1}{1+\frac{4\tau\omega}{j[\tau^2\omega^2-1]}} = \frac{1}{1-\frac{4j\tau\omega}{\tau^2\omega^2-1}} = \frac{\tau^2\omega^2-1}{\tau^2\omega^2-1-4j\tau\omega}$$

$$\left|\frac{v_0}{v_e}\right| = \frac{|1-\tau^2\omega^2|}{\sqrt{(\tau^2\omega^2-1)^2+16\tau^2\omega^2}}$$

car pour étudier cette fct° il faut en prendre le module.

qd $\omega \to 0$ $\left|\frac{v_s}{v_e}\right| \to 1$

$\omega \to +\infty$ $\left|\frac{v_s}{v_e}\right| \to 1$ $\left(\frac{1}{1 - \frac{4j\tau\omega}{\tau^2\omega^2 - 1}}\right)$

$\omega \to 1/\tau$ $\left|\frac{v_s}{v_e}\right| \to 0$

filtre passe bande réjecteur de la pulsation $\omega_0 = 1/\tau = 1/RC$

fréquence de coupure

$$\left|\frac{v_e}{v_s}\right|_{\omega=\omega_c} = \frac{\max}{\sqrt{2}} \frac{v_s}{v_e} = 1/\sqrt{2}$$

$$\left|\frac{v_s}{v_e}\right|^2 = \frac{1}{2} = \frac{(1-\tau^2\omega_c^2)}{(1-\tau^2\omega_c^2)^2 + 16\tau^2\omega_c^2}$$

$$2(1-\tau^2\omega_c^2)^2 = (1-\tau^2\omega_c^2)^2 + 16\tau^2\omega_c^2$$

$$(1-\tau^2\omega_c^2)^2 = 16\tau^2\omega_c^2 \Rightarrow 1-\tau^2\omega_c^2 = \pm 4\tau\omega_c$$

$$\tau^2\omega_c^2 \pm 4\tau\omega_c - 1 = 0 \qquad \Delta = 16\tau^2 + 4\tau^2 = 20\tau^2$$

$$\omega_{c\,1,2} = \frac{\mp 4\tau \pm 2\tau\sqrt{5}}{2\tau^2}$$ fréqu > 0 ~~tjs~~ 1 seule solut°

$$\omega_{c\,1,2} = \pm\frac{2}{\tau} + \frac{1}{\tau}\sqrt{5} = \frac{2}{\tau}\left[\frac{\sqrt{5}}{2} \mp 1\right]$$

$$\omega_{c\,1\,2} = \begin{matrix} 0.236/2 \\ 4,236/2 \end{matrix}$$

$\Delta\omega = 4/\tau$.