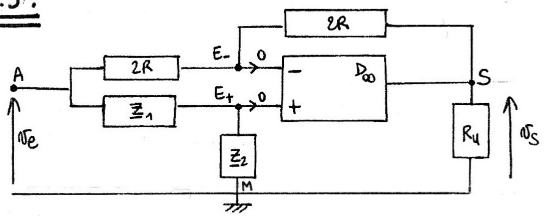
EXE 5.9 :



1) Loi des noeuds en Termes de Pot en E_+ :

$$\frac{V_e - V_{E_+}}{\underline{Z}_1} + \frac{\cancel{V_M} - V_{E_+}}{\underline{Z}_2} + 0 = 0 \quad (1)$$

Loi des noeuds en Termes de Pot. en E_- :

$$\frac{V_e - V_{E_-}}{2R} + \frac{V_s - V_{E_-}}{2R} + 0 = 0 \quad (2)$$

$$(2) \Rightarrow \underline{V_s} = 2\underline{V_{E_-}} - \underline{V_e} \quad (2)$$

$$(1) \rightarrow V_{E_+}\left(\frac{1}{\underline{Z}_1} + \frac{1}{\underline{Z}_2}\right) = \frac{V_e}{\underline{Z}_1} \rightarrow V_{E_+} = \frac{\underline{Z}_2}{\underline{Z}_1 + \underline{Z}_2} V_e \quad (1)$$

AO en régime linéaire + AO Idéal donc $V_{E_+} = V_{E_-}$

$$\underline{V_s} = \left(\frac{2\underline{Z}_2}{\underline{Z}_1 + \underline{Z}_2} - 1\right)\underline{V_e} \quad (3)$$

$$(3) \quad \boxed{\frac{\underline{V_s}}{\underline{V_e}} = \frac{\underline{Z}_2 - \underline{Z}_1}{\underline{Z}_2 + \underline{Z}_1} = \underline{H}(j\omega)}$$

2) $\underline{Z}_1 = R \qquad \underline{Z}_2 = \dfrac{1}{jC\omega}$

$$\boxed{\underline{H}(j\omega) = \frac{\frac{1}{jC\omega} - R}{\frac{1}{jC\omega} + R} = \frac{1 - jRC\omega}{1 + jRC\omega} = \frac{1 - jx}{1 + jx}}$$

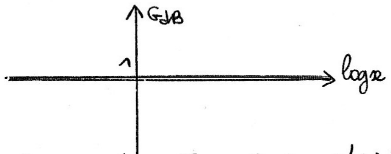
$$x = \frac{\omega}{\omega_0} \qquad \omega_0 = \frac{1}{RC}$$

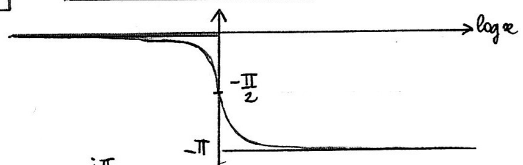
$$G_{dB} = 20\log|\underline{H}(j\omega)| = 10\log(1 + x^2) - 10\log(1 + x^2) = 0$$

$$\phi = \arg \underline{H}(j\omega) = \arg(1 - jx) - \arg(1 + jx) = \arctan\frac{-x}{1} - \arctan\frac{+x}{1}$$

$$\boxed{G_{dB} = 0 \qquad \phi = \arg \underline{H} = -2\arctan x.}$$

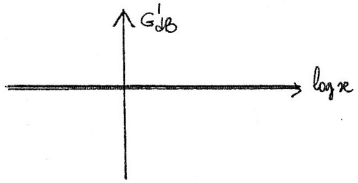
FILTRE DÉPHASEUR

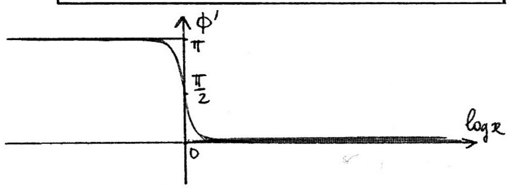




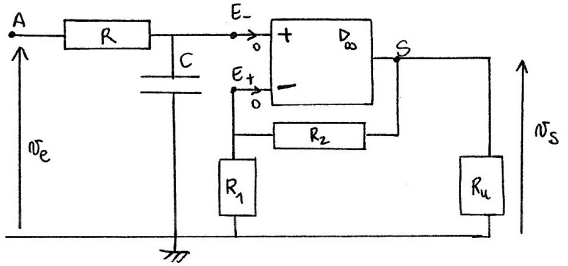
3) $\underline{Z}_1 = \dfrac{1}{jC\omega} \qquad \underline{Z}_2 = R \rightarrow \underline{H}'(j\omega) = -\underline{H}(j\omega) = e^{j\pi}\underline{H}(j\omega)$

On tombe sur un filtre déphaseur différent : $\boxed{G'_{dB} = 0 \qquad \phi' = \arg \underline{H}' = \pi - 2\arctan x}$





EXE 5.10 :



1) Loi des Noeuds en T. de Pot. en E_- :

$$\frac{V_e - V_{E_-}}{R} + \frac{\cancel{V_M} - V_{E_-}}{\frac{1}{jC\omega}} = 0 \quad (1)$$

Loi des N. en T. de Pot. en E_+ :

$$\frac{\cancel{V_M} - V_{E_+}}{R_1} + \frac{V_s - V_{E_+}}{R_2} = 0 \quad (2)$$

AO Idéal : $V_{E_-} = V_{E_+} \quad (3)$

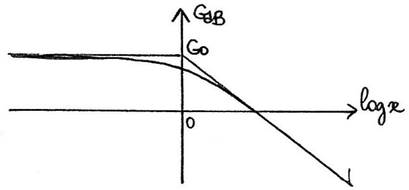
$$(1) \rightarrow V_{E_-}\left(\frac{1}{R} + jC\omega\right) = \frac{V_e}{R} \quad (1) \qquad (2) \rightarrow V_{E_+}\left(\frac{1}{R_1} + \frac{1}{R_2}\right) = \frac{V_s}{R_2} \quad (2)$$

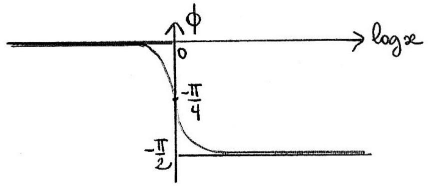
$$\frac{(2)}{(1)} \xrightarrow{(3)} \frac{\frac{V_s}{R_2}}{\frac{V_e}{R}} = \frac{\frac{1}{R_1} + \frac{1}{R_2}}{\frac{1}{R} + jC\omega} \rightarrow \boxed{\frac{\underline{V_s}}{\underline{V_e}} = \frac{\cancel{R_2}}{R}\,\frac{R_1 + R_2}{R_1\cancel{R_2}}\,\frac{1}{\frac{1}{R} + jC\omega} = \frac{\frac{R_1 + R_2}{R_1}}{1 + jRC\omega}}$$

$$\boxed{H_0 \equiv \frac{R_1 + R_2}{R_1} \qquad \omega_0 \equiv \frac{1}{RC} \rightarrow \underline{H}(j\omega) = \frac{H_0}{1 + jx} \quad \text{avec } x = \frac{\omega}{\omega_0}} \qquad \boxed{\begin{array}{l}\omega_c = \omega_0 \\ BP : [0, \omega_0]\end{array}}$$

2) $G_{dB} = 20\log H_0 - 10\log(1 + x^2) = G_0 + G_{dB_{PB}}$

$\phi = \arg \underline{H} = -\arctan x = \phi_{PB}$





Pulsat° de Coupure $\quad G_{dB}(\omega_c) = G_{dB}(max) - 3\,dB = G_0 \overbrace{- 3\,dB}^{-10\log 2} = G_0 - 10\log(1 + x_c^2)$

$$\hookrightarrow x_c = 1 = \frac{\omega}{\omega_0}$$

3) On veut : $\begin{cases} \omega_0 = \dfrac{1}{RC} = 2\pi f_0 \text{ tel que} \\ G_0 = 20\log\left(\dfrac{R_1 + R_2}{R_1}\right) = 3\,dB \end{cases}$ $\begin{cases} f_0 = \dfrac{1}{2\pi RC} = 10^3\ Hz \\ G_0 = 20\log\left(1 + \dfrac{R_2}{R_1}\right) = 10\log 2 \end{cases}$ (*) $\Leftrightarrow \begin{cases} RC = \dfrac{1}{2\pi\,10^3} \ (\Delta) \\ \left(1 + \dfrac{R_2}{R_1}\right)^2 = 2 \end{cases}$

$$\boxed{\begin{array}{l} RC = \dfrac{1}{2\pi.10^3} \ (\Delta) \\ \dfrac{R_2}{R_1} = \sqrt{2} - 1 \end{array}} \rightarrow \begin{cases} \text{si } R = 10\,k\Omega \quad C \simeq 1{,}6.10^{-8}\ F = 16\ nF \\ \text{si } R_1 = 10\,k\Omega \quad R_2 = 4{,}1\ k\Omega \end{cases}$$

(*) Si on ne pense pas à $\log 2 = 0{,}3 \rightarrow \log\left(1 + \frac{R_2}{R_1}\right) = \frac{3}{20} \rightarrow \frac{R_2}{R_1} = 10^{\frac{3}{20}} - 1$