Exercice n°2

1) $\underline{T_1} = \dfrac{\underline{V^+}}{\underline{V_E}} = \dfrac{\underline{Z_{C1}}}{\underline{Z_{R1}} + \underline{Z_{C1}}} = \dfrac{\frac{1}{jC_1\omega}}{R_1 + \frac{1}{jC_1\omega}} = \dfrac{1}{1+jR_1C_1\omega}$

2) $\underline{T_2} = \dfrac{\underline{V_S}}{\underline{V}} = \dfrac{1}{1+jR_2C_2\omega}$ (par analogie à $\underline{T_1}$)

3) $\underline{T} = \dfrac{\underline{V_S}}{\underline{V_E}} = \dfrac{\underline{V_S}}{\underline{V}} \cdot \dfrac{\underline{V}}{\underline{V^+}} \cdot \dfrac{\underline{V^+}}{\underline{V_E}} = \underline{T_1} \cdot \underline{T_{suiveur}} \cdot \underline{T_2} = \underline{T_1} \cdot 1 \cdot \underline{T_2} = \underline{T_1} \cdot \underline{T_2}$ (CQFD)

4) $\underline{T} = \underline{T_1} \cdot \underline{T_2} = \dfrac{1}{(1+jR_1C_1\omega)(1+jR_2C_2\omega)} = \dfrac{1}{\left(1+j\frac{F}{F_{C1}}\right)\left(1+j\frac{F}{F_{C2}}\right)}$ ssi $\begin{cases} R_1C_1\omega = \dfrac{F}{F_{C1}} \\ R_2C_2\omega = \dfrac{F}{F_{C2}} \end{cases}$

donc ssi $\boxed{f_{C1} = \dfrac{1}{2\pi R_1C_1}}$ et $\boxed{f_{C2} = \dfrac{1}{2\pi R_2C_2}}$

5)
- $G_{max} = 20 \cdot \log |\underline{T}|_{max}$

or $|\underline{T}| = \dfrac{1}{\sqrt{1+\left(\frac{F}{F_{C1}}\right)^2} \cdot \sqrt{1+\left(\frac{F}{F_{C2}}\right)^2}}$ donc $|\underline{T}|$ est au max ssi $\boxed{F=0}$

$\Rightarrow |\underline{T}|_{max} = 1$ donc $\boxed{G_{max} =$

- $f = f_c$ ssi $G = G_{max} - 3\text{ dB} \Leftrightarrow |\underline{T}| = \dfrac{|\underline{T}|_{max}}{\sqrt{2}}$

$$\frac{1}{\sqrt{1+\left(\frac{f_c}{f_{C1}}\right)^2} \cdot \sqrt{1+\left(\frac{f_c}{f_{C2}}\right)^2}} = \frac{1}{\sqrt{2}}$$

$\Rightarrow \left[1+\left(\frac{F_c}{F_{C1}}\right)^2\right] \cdot \left[1+\left(\frac{F_c}{F_{C2}}\right)^2\right] = 2 \Rightarrow 1 + \left(\frac{F_c}{F_{C1}}\right)^2 + \left(\frac{F_c}{F_{C2}}\right)^2 + \left(\frac{F_c^2}{F_{C1}F_{C2}}\right)^2 = 2$

$\Rightarrow \dfrac{F_c^2}{(F_{C1})^2} + \dfrac{F_c^2}{(F_{C2})^2} + \dfrac{F_c^4}{(F_{C1}F_{C2})^2} = 1$

On Pose : $X = F_c^2$ $\longrightarrow$ $\Rightarrow \left[\dfrac{1}{(F_{C1})^2} + \dfrac{1}{(F_{C2})^2}\right] \cdot X + \dfrac{X^2}{(F_{C1}F_{C2})^2} - 1 = 0$

AN

discriminant : $\Delta = \left[\dfrac{1}{(F_{C1})^2} + \dfrac{1}{(F_{C2})^2}\right]^2 + 4\dfrac{1}{(F_{C1}F_{C2})^2} = 156 \cdot 10$

racines : $X_{\frac{1}{2}} = \dfrac{-\left[\frac{1}{(F_{C1})^2} + \frac{1}{(F_{C2})^2}\right] \pm \sqrt{\Delta}}{\frac{2}{(F_{C1}F_{C2})^2}} =$ $\nearrow$ $2{,}53 \cdot 10$; $\searrow$ $-25{,}3 \cdot 1$

Physiquement impossible !

$F_c = \sqrt{X}$ $\longleftarrow$

$\boxed{F_c = 1{,}59\text{ kHz} \simeq F_{C2}}$

6) Le Filtre réalisé est un filtre Passif ($G_{max} = 0\text{dB}$), Passe-Bas (quand $f \nearrow$ $|\underline{T}| \searrow$), du 2nd ordre

Effectivement pour $f \to \infty \Rightarrow G = 20 \log |\underline{T}| \longrightarrow 20 \log \left(\dfrac{F_{C1}F_{C2}}{F^2}\right)$

$\Rightarrow$ à $10 \cdot f$ (1 décade) : $G \to 20 \cdot \log\left(\dfrac{F_{C1}F_{C2}}{F^2}\right) - 40\text{dB}$!!