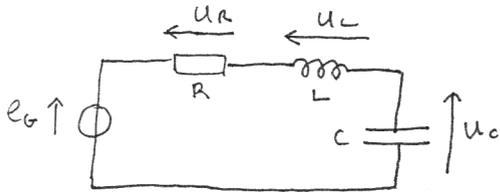


Résumé RLC série Régime sinusoïdal forcé.



$$e_G(t) = E_M \cos(\omega t + \varphi_G); \quad Z_e = \frac{L}{R}; \quad \omega_0 = \frac{1}{\sqrt{LC}}; \quad Q = \omega_0 Z_e$$

	$\mathcal{H}_C = \frac{u_C}{e_G}$	$\mathcal{H}_R = \frac{u_R}{e_G}$	$\mathcal{H}_L = \frac{u_L}{e_G}$
Nature du filtre	passé-bas	passé-bande	passé-haut
Résonance	<ul style="list-style-type: none"> Si $Q \leq 1/\sqrt{2}$: pas de résonance. Si $Q > 1/\sqrt{2}$: <u>résonance de charge</u>, et de tension $\omega_r < \omega_0$ $\omega_r = \omega_0 \sqrt{1 - \frac{1}{2Q^2}}$	$\forall Q, \quad \omega_r = \omega_0$ <u>résonance d'intensité</u> , et de puissance $ Z _r = Z _{\min} = R$ avec: $Z = R + j\omega L + \frac{1}{j\omega C}$	<ul style="list-style-type: none"> Si $Q \leq 1/\sqrt{2}$: pas de résonance. Si $Q > 1/\sqrt{2}$: <u>résonance</u> $\omega_r > \omega_0$ $\omega_r = \omega_0 / \sqrt{1 - \frac{1}{2Q^2}}$
Sur-tension	<ul style="list-style-type: none"> Si $Q > 1/\sqrt{2}$: $\left(\frac{U_{CM}}{E_M}\right)_{\omega_r} = \frac{Q}{\sqrt{1 - \frac{1}{4Q^2}}} \approx Q \quad \text{si } Q \gg 1$	pas de sur-tension: $\left(\frac{U_M}{E_M}\right)_{\omega_r} = 1$	<ul style="list-style-type: none"> Si $Q > 1/\sqrt{2}$: $\left(\frac{U_{CM}}{E_M}\right)_{\omega_r} = \frac{Q}{\sqrt{1 - \frac{1}{4Q^2}}} \approx Q \quad \text{si } Q \gg 1$
$G(\omega)$			
$G^{dB}(\omega)$			
$\varphi(\omega)$			

Étude de la résonance d'intensité du circuit

RLC série

II - Étude théo.: a) $\underline{u}_2 = \frac{R'}{R' + r + Z_C + Z_L} \underline{u}_1$ et $\begin{cases} \underline{u}_1 = E e^{j\varphi} \\ \underline{u}_2 = R' \underline{i} \\ \underline{i} = I \end{cases}$

$= \frac{R'}{R + \frac{1}{j\omega C} + j\omega L} \underline{u}_1$

$\Rightarrow \underline{u}_2 = \frac{R'}{R + j(L\omega - \frac{1}{C\omega})} \underline{u}_1 \Rightarrow R' I = \frac{R'}{\sqrt{R^2 + (L\omega - \frac{1}{C\omega})^2}} E \Rightarrow I(\omega) = \frac{E}{\sqrt{R^2 + (L\omega - \frac{1}{C\omega})^2}}$

argument $\Rightarrow \tan \varphi = \frac{1}{R} (L\omega - \frac{1}{C\omega})$

b) • $\omega_r / I(\omega_r) = I_{max}$; $I_{max} \Rightarrow (L\omega_r - \frac{1}{C\omega_r})^2 = 0 \Rightarrow \omega_r = \frac{1}{\sqrt{LC}} = \omega_0$

$\Rightarrow I_r = \frac{E}{R} = I_{max}$

$\Rightarrow f_r = \frac{1}{2\pi\sqrt{LC}}$

• $\tan \varphi_r = 0 \Rightarrow \varphi_r = 0$

c) $\omega_c / I(\omega_c) = \frac{I_{max}}{\sqrt{2}} \Rightarrow I(\omega_c) = \frac{I_{max}}{\sqrt{2}} = \frac{I_{max}}{\sqrt{1 + \frac{1}{R^2}(L\omega_c - \frac{1}{C\omega_c})^2}}$

$\Rightarrow (L\omega_c - \frac{1}{C\omega_c}) = \pm R \Rightarrow LC\omega_c^2 \mp RC\omega_c - 1 = 0$

$\Rightarrow u^2 \mp RC\omega_0 u - 1 = 0$ avec $u_c = \frac{\omega_c}{\omega_0}$

$Q = \omega_0 L = \frac{1}{\sqrt{LC}} \frac{L}{R} = \frac{\sqrt{L}}{R} \frac{1}{\sqrt{C}} ; RC\omega_0 = R\sqrt{\frac{C}{L}} = \frac{1}{Q}$

$\Rightarrow u_c^2 \mp \frac{u_c}{Q} - 1 = 0 \Rightarrow u_c = \frac{\pm \frac{1}{Q} \pm \sqrt{\frac{1}{Q^2} + 4}}{2} \Rightarrow \begin{cases} u_h = \sqrt{1 + \frac{1}{4Q^2}} + \frac{1}{2Q} \\ u_b = \sqrt{1 + \frac{1}{4Q^2}} - \frac{1}{2Q} \end{cases}$

soit: $\begin{cases} \omega_h = \omega_0 \left[\sqrt{1 + \frac{1}{4Q^2}} + \frac{1}{2Q} \right] \\ \omega_b = \omega_0 \left[\sqrt{1 + \frac{1}{4Q^2}} - \frac{1}{2Q} \right] \end{cases} \Rightarrow \omega_h - \omega_b = \frac{\omega_0}{Q}$

d) $(L\omega - \frac{1}{C\omega}) = \pm R \Rightarrow \tan \varphi = \pm 1 \Rightarrow \varphi = \pm \frac{\pi}{4} \Rightarrow \begin{cases} \varphi_h = + \frac{\pi}{4} \\ \varphi_b = - \frac{\pi}{4} \end{cases}$

Pour ce circuit déterminons les valeurs théoriques de :

$Q ; f_0 ; f_h ; f_b$