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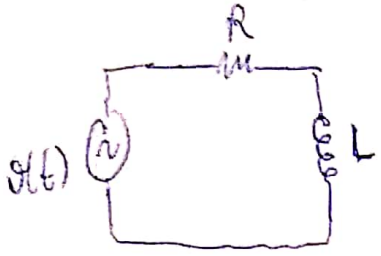
Exemplo numérico 11

Circuito RL série: $R = 1\,\Omega$, $L = 10\,mH$

$v(t) = 100 \cos \omega t$



$$v_R(t) + v_L(t) = 100 \cos 377t$$

$$\frac{di(t)}{dt} + \frac{R\,i(t)}{L} = 10000 \cos 377t$$

$$\frac{di(t)}{dt} + 100\,i(t) = 10000 \cos 377t$$

$$i(t) = Ke^{\frac{R}{L}t} + K_1 \cos 377t + K_2 \operatorname{sen} 377t$$

$$i_p(t) = K_1 \cos 377t + K_2 \operatorname{sen} 377t$$

$$\frac{di_p(t)}{dt} = -377K_1 \operatorname{sen}(377t) + 377K_2 \cos(377t)$$

Substituindo:

$$-377K_1 \operatorname{sen}(377t) + 377K_2 \cos 377t + 100K_1 \cos 377t + 100K_2 \operatorname{sen} 377t = 10000 \operatorname{sen} 377t$$

Temos: $K_1 = 6{,}57$ e $K_2 = 24{,}78$

Logo: $i_p(t) = 6{,}57 \cos 377t + 24{,}78 \operatorname{sen} 377t$

$$\Rightarrow i(t) = Ke^{-100t} + 6{,}57 \cos 377t + 24{,}78 \operatorname{sen} 377t$$

para $i(0) \Rightarrow \quad i(0) = K + 6,57 = 0$

$$K = -6,57$$

$$\boxed{i(t) = -6,57 \cdot e^{-100t} + 6,57 \cos 377t + 24,78 \operatorname{sen} 377t}$$

(para $t \geq 0$)

Exemplo numérico 11

Circuito RC série: $\begin{cases} R = 10\,\Omega \\ C = 5\,mF \\ v(t) = ~~200(\omega t + 30°)~~ \\ \qquad 200 \operatorname{sen}(\omega t + 30°) \end{cases}$

$$i(t) = Ke^{-20t} + K_1 \cos(\omega t + 30°) + K_2 \operatorname{sen}(\omega t + 30°)$$

$$\frac{di(t)}{dt} + 20\, i(t) = 7540 \cos(377t + 30°)$$

$K_1 = 1,058$
$K_2 = 19,94$

$$\Rightarrow \quad i(t) = Ke^{-20t} + 1,058 \cos(\omega t + 30°) + 19,94 \operatorname{sen}(\omega t + 30°)$$

$$i(0) = K + 1,058 \cos 30° + 19,94 \operatorname{sen} 30° = 10$$

$$K = -0,88$$

$$\boxed{i(t) = -0,88 \cdot e^{-20t} + 1,058 \cos(\omega t + 30°) + 19,94 \operatorname{sen}(\omega t + 30°)}$$

$(t \geq 0)$

* Exemplo numérico 12

Circuito LC série: $\begin{cases} v(t) = 100\,\mathrm{sen}(wt+10^\circ) \\ L = 20\,mH \\ C = 5\,mF \end{cases}$

$$\frac{d^2 i(t)}{dt^2} + \frac{1}{LC} i(t) = \frac{377 \times 100}{20 \times 10^{-3}} \cos(377 + 10^\circ)$$

$$D^2 + \frac{1}{LC} = 0 \Rightarrow$$

$$r_{1,2} = \pm j w_0$$

$$w_0 = \frac{1}{\sqrt{LC}} = 100 \Rightarrow i_h(t) = K_1 e^{j100t} + K_2 e^{-j100t}$$

$$i_h(t) = C_1 \cos(100t) + C_2 \mathrm{sen}(100t)$$

$$i_p(t) = I_m \,\mathrm{sen}(wt + 10^\circ - \theta_2)$$

$$I_m = \frac{100}{\sqrt{(7{,}54 - 9{,}53)^2}} = 14{,}26$$

$$\theta_2 = \mathrm{arctg}\left(\frac{7{,}01}{0}\right) \Rightarrow = 90^\circ$$

$$i_p(t) = 14{,}26\,\mathrm{sen}(wt - 80^\circ)$$

$$i(t) = C_1 \cos 100t + C_2 \operatorname{sen} 100t + 14{,}26 \operatorname{sen}(\omega t - 80^\circ)$$

$$i(0) = C_1 - 14{,}04 \Rightarrow C_1 = 14{,}04$$

$$\frac{d}{dt} i(t) = -100 C_1 \operatorname{sen} 100t + 100 C_2 \cos 100t + 14{,}26 \times 377 \cos(\omega t - 80^\circ)$$

$$\frac{d}{dt} i(0) = 100 C_2 + 933{,}53 = 868{,}24$$

$$C_2 = -0{,}653$$

$$i(t) = 14{,}04 \cos 100t - 0{,}653 \operatorname{sen} 100t + 14{,}26 \operatorname{sen}(\omega t - 80^\circ)$$

* Exemplo numérico 13

Circuito RLC:

$$\frac{d^2}{dt^2} i(t) + \frac{R}{L} \frac{d}{dt} i(t) + \frac{1}{LC} i(t) = \frac{d}{dt} v(t)$$

$$D^2 + \frac{R}{L} D + \frac{1}{LC} = 0$$

e) RLC Série com $\Delta < 0$

$v(t) = 120(377t + 40^\circ)$

$R = 2\Omega$, $L = 20mH$, $C = 5mF$

$s_{1,2} = -50 \pm j86,6$

$i_h(t) = e^{-50t} \cdot [C_1 \cos(86,6t) + C_2 \operatorname{sen}(86,6t)]$

$i_p(t) = Im \operatorname{sen}(wt + 40 - \theta_2)$

$$I_m = \frac{120}{\sqrt{4 + (7,54 - 0,53)^2}} = 16,46$$

$\theta_2 = \operatorname{arctg}\left(\frac{7,01}{2}\right) \Rightarrow \theta_2 = 74,076^\circ$

$i(t) = e^{-50t} \cdot [C_1 \cos(86,6t) + C_2 \operatorname{sen}(86,6t)] + 16,46 \operatorname{sen}(wt - 34,070)$

$C_1 = 9,22$

$C_2 = -9,5$

$i(t) = [9,22 \cos(86,6t) - 9,5 \operatorname{sen}(86,6t)] e^{-50t} + 16,46 \operatorname{sen}(wt - 34,070)$