$$v(t) = V \sin(\omega t + \theta)$$

$$i(t) = I \sin(\omega t + \varphi)$$

$\omega\left[{}^{rad}\!/_{s}\right]-$ frequência angular.

$\omega = 2\pi f$

$\theta[rad]-$ fase na origem do tempo.

$f\,[Hz]-$ frequência.

$f = \dfrac{1}{T}$

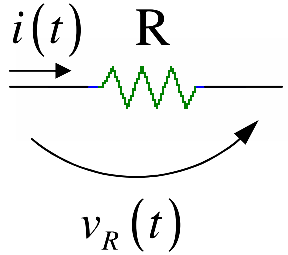
$T[s]-$ período.

Tensão eficaz de uma tensão AC: valor de tensão DC capaz de dissipar a mesma potência média numa dada resistência.

Seja: $i(t) = I_x \cos(\omega t)$

Definindo-se: $I = I_x e^{j\omega t}$

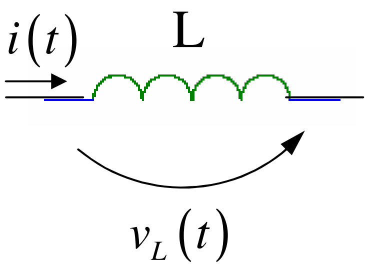
$i(t) = \mathrm{Re}\{I\}$



$V_R = RI \qquad V_R = RI_x e^{j\omega t}$

$v_R(t) = \mathrm{Re}\{V_R\}$

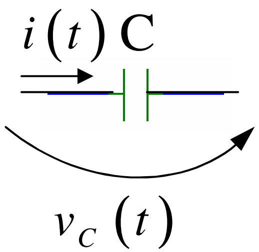
$v_R(t) = RI_x \cos(\omega t)$



$V_L = Z_L I, \quad Z_L = j\omega L$

$v_L(t) = \mathrm{Re}\{V_L\}$

$$v_L(t) = \omega L I_x \cos\left(\omega t + \frac{\pi}{2}\right)$$

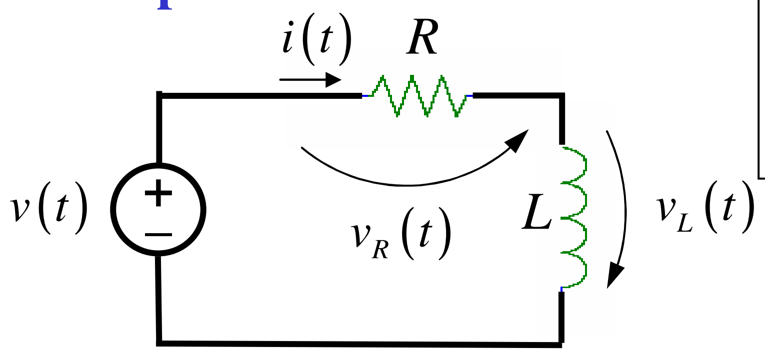


$$V_C = Z_C I, \quad Z_C = \frac{1}{j\omega C}$$

$v_C(t) = \mathrm{Re}\{V_C\}$

$$v_C(t) = \frac{I_x}{\omega C} \cos\left(\omega t - \frac{\pi}{2}\right)$$

Exemplo:



$$v(t) = V_S \cos(\omega t), \quad V_S = 4V, \quad \omega = 20\, {krad}/{s}$$

$$R = 100\Omega \quad L = 2mH$$

$$i(t)?$$

Lei de Kirchhoff do equilíbrio das tensões:

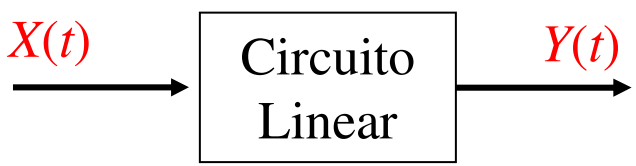
Seja: $i(t) = I_S \cos(\omega t + \Phi)$

$$v(t) = v_R(t) + v_L(t)$$

●●●

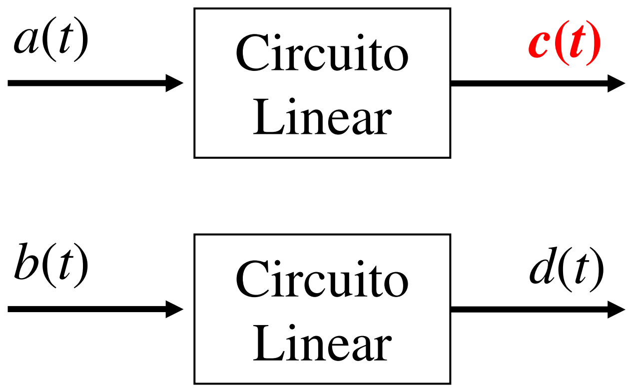
$$I_S = \frac{V_S}{\sqrt{R^2 + \omega^2 L^2}} = 37mA \qquad \Phi = -\arctan\frac{\omega L}{R} = -0.38rad$$

PRINCÍPIO DA LINEARIDADE

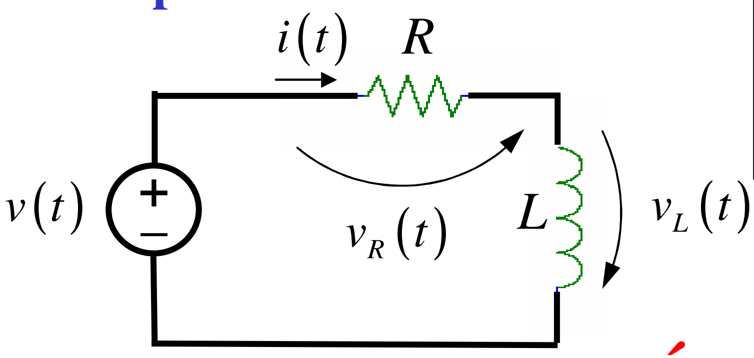


Se $X(t) = a(t) + b(t)\,j, \quad Y(t) = c(t) + d(t)\,j$ **então:**

$$c(t) = \mathrm{Re}\{Y(t)\}$$



Exemplo:

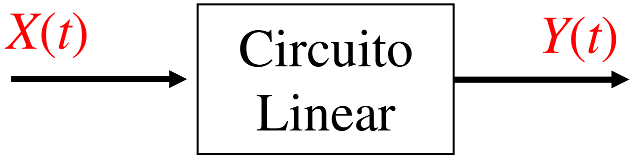


$$v(t)=V_S\cos(\omega t),\quad V_S=4V,\quad \omega=20\,{krad}/{s}$$

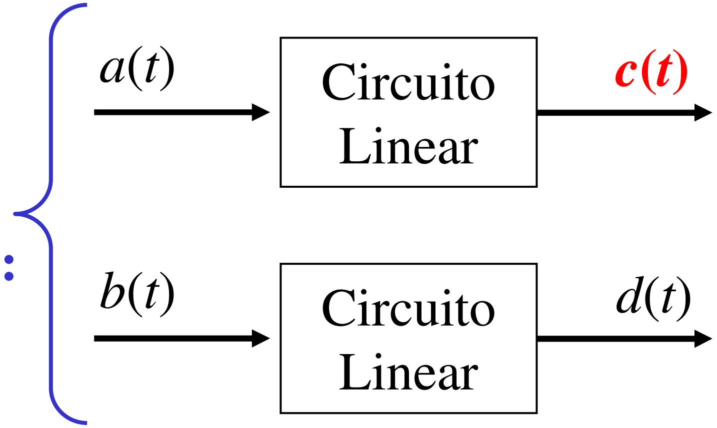
$$R=100\Omega \quad L=2mH$$

$$i(t)?$$

PRINCÍPIO DA LINEARIDADE



Se $X(t)=a(t)+b(t)\,j,\quad Y(t)=c(t)+d(t)\,j$ **então:**

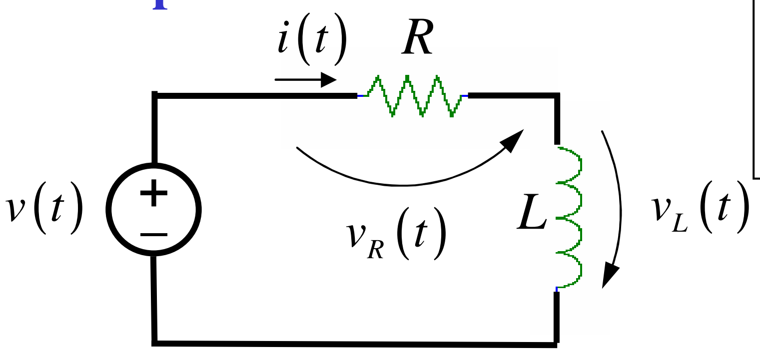


$$c(t)=\mathrm{Re}\{Y(t)\}$$

Reais ⟷ Funções trigonométricas

Complexos ⟷ Funções exponenciais

Exemplo:



$v(t) = V_S \cos(\omega t)$, $V_S = 4V$, $\omega = 20\, krad/s$

$R = 100\Omega$ $L = 2mH$

$i(t)$?

$$V = V_S e^{j(\omega t)}$$

Seja: $i(t) = I_S \cos(\omega t + \Phi)$

$$I = I_S e^{j(\omega t + \Phi)}$$

Lei de Kirchhoff do equilíbrio das tensões

$$V = V_R + V_L$$

$$V_S e^{j\omega t} = R I_S e^{j(\omega t+\Phi)} + Z_L I_S e^{j(\omega t+\Phi)}, \quad Z_L = j\omega L$$

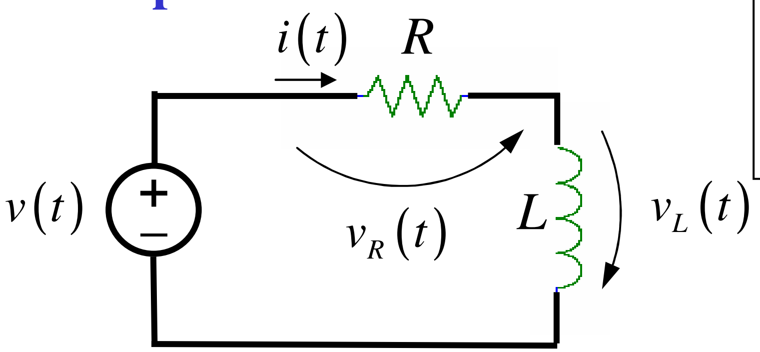
•••

$$V_S e^{j\omega t} = I_S \sqrt{R^2+\omega^2 L^2}\, e^{j\left(\omega t+\Phi+\arctan\frac{\omega L}{R}\right)}$$

$$\begin{cases} I_S = \dfrac{V_S}{\sqrt{R^2+\omega^2 L^2}} \\ \Phi = -\arctan\dfrac{\omega L}{R} \end{cases}$$

$$\boxed{i(t) = \mathrm{Re}\{I\} = \frac{V_S}{\sqrt{R^2+\omega^2 L^2}} \cos\left(\omega t - \arctan\frac{\omega L}{R}\right)}$$

Exemplo:



$$v(t) = V_S\cos(\omega t), \quad V_S = 4V, \quad \omega = 20\,krad/s$$

$$R = 100\Omega \quad L = 2mH$$

$i(t)$?

$$V = V_S e^{j(\omega t)}$$

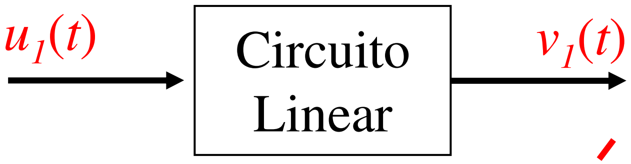
Seja: $i(t) = I_S\cos(\omega t + \Phi)$

$$I = I_S e^{j(\omega t+\Phi)}$$

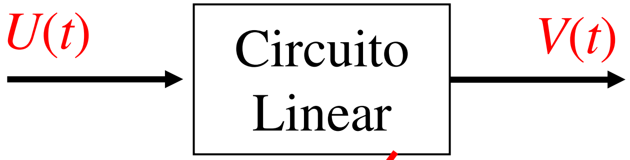
Lei de Kirchhoff do equilíbrio das tensões $V = V_R + V_L$

$$V_S e^{j\omega t} = RI_S e^{j(\omega t+\Phi)} + Z_L I_S e^{j(\omega t+\Phi)}, \quad Z_L = j\omega L$$

PRINCÍPIO DA LINEARIDADE



então:



$$U(t) = ku_1(t)$$

$$V(t) = kv_1(t)$$

$$V_S e^{j\omega t} = RI_S e^{j\Phi} e^{j\omega t} + j\omega L I_S e^{j\Phi} e^{j\omega t}$$

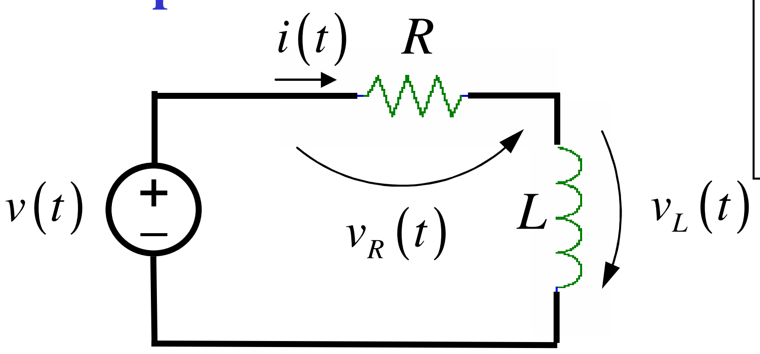
$$V = V_S e^{j(\omega t)}$$

$$k \Leftrightarrow e^{j(\omega t)}$$

•••

$$V_S = I_S\sqrt{R^2+\omega^2L^2}\,e^{j\left(\Phi+\arctan\frac{\omega L}{R}\right)}$$

Exemplo:



$$v(t) = V_S \cos(\omega t), \quad V_S = 4V, \quad \omega = 20\, {}^{krad}\!/_{s}$$

$$R = 100\Omega \quad L = 2mH$$

$$i(t)?$$

$$V = V_S e^{j(0)}$$

Seja: $i(t) = I_S \cos(\omega t + \Phi)$

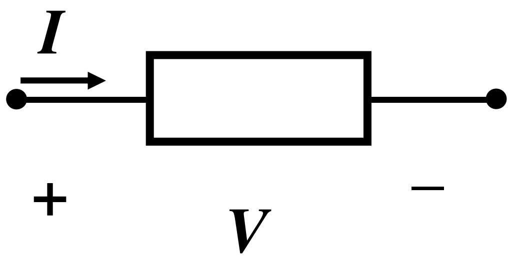
$$I = I_S e^{j\Phi}$$

$$V_S = I_S \sqrt{R^2 + \omega^2 L^2}\, e^{j\left(\Phi + \arctan\frac{\omega L}{R}\right)}$$

$$\begin{cases} I_S = \dfrac{V_S}{\sqrt{R^2 + \omega^2 L^2}} \\ \Phi = -\arctan\dfrac{\omega L}{R} \end{cases}$$

$$i(t) = \mathrm{Re}\left\{I e^{j\omega t}\right\} = \frac{V_S}{\sqrt{R^2 + \omega^2 L^2}} \cos\left(\omega t - \arctan\frac{\omega L}{R}\right)$$

IMPEDÂNCIA GENERALIZADA



$$\frac{V}{I} = Z$$

- $Z = R$ **resistência**
- $Z = \dfrac{1}{j\omega C}$ **condensador**
- $Z = j\omega L$ **bobine**

- **SÉRIE:** $Z_{eq} = \sum_{k=1}^{n} Z_k$
- **PARALELO:** $Y_{eq} = \sum_{k=1}^{n} Y_k, \quad Y = \dfrac{1}{Z}$