Filtros

Passa Alta & Baixa

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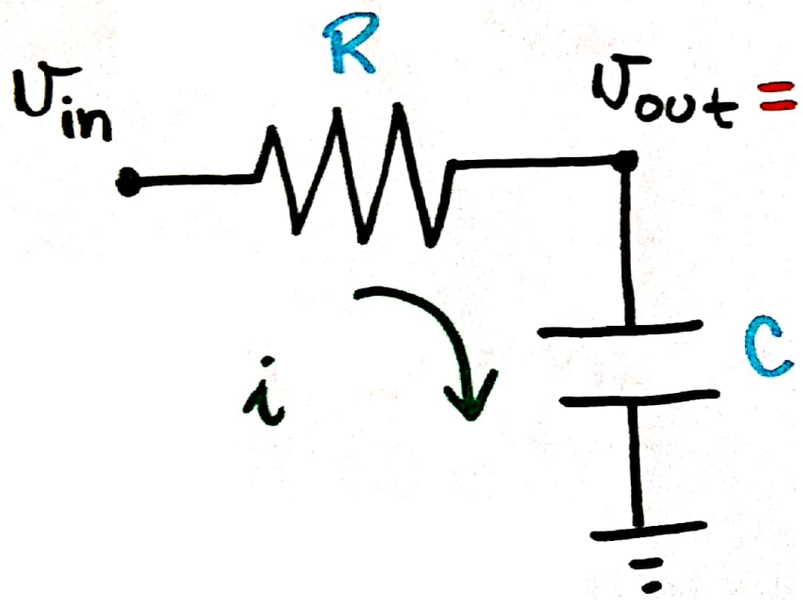
ICMC CeMEAI USP

Passa baixa



LEI DO OHM

$$v_{in} - v_{out} = Ri \qquad (1)$$

&

$$q = Cv_c$$

ou

$$i = Cv_c = C\dot{v}_{out} \qquad (2)$$

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SUBS (2) EM (1)

$$v_{in} - v_{out} = RC\,\dot{v}_{out}$$

OU

$$RC\,\dot{v}_{out} + v_{out} = v_{in} \qquad (3)$$

EDO

FORÇAMENTO

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TRANSFORMANDO (3)

$$(1+RCs)V_{out}(s) = V_{in}(s)$$

OU

$$V_{out}(s) = W(s)\,V_{in}(s)$$

$$W(s) = \frac{1}{1+RCs}$$

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PARA ONDA HARMÔNICA

$$v_{in} = v_0 \sin \omega t \implies \hat{v}_{in} = v_0 e^{j\omega t}$$

ω ↳ freq.

SABEMOS QUE

$$V_{out}(s) = W(j\omega) V_{in} \implies W(j\omega) = \frac{1}{1 + jRC\omega}$$

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Recap: $W(j\omega) = |W(j\omega)| e^{j\phi}$

$\Rightarrow \quad |V_{out}(s)| = |W(j\omega)| \, |V_{in}(s)| \Rightarrow$

GANHO

$$|W(j\omega)| = \frac{|V_{out}(s)|}{|V_{in}(s)|}$$

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O GANHO EM AMPLITUDE É $|W(j\omega)|$

$$|W(j\omega)|^2 = W(j\omega)\overline{W(j\omega)}$$

$$= \frac{1}{1+jRC\omega}\,\frac{1}{1-jRC\omega}$$

$$= \frac{1}{1+(RC)^2\omega^2} \Rightarrow \left|W(j\omega)\right| = \frac{1}{\sqrt{1+(RC)^2\omega^2}}$$

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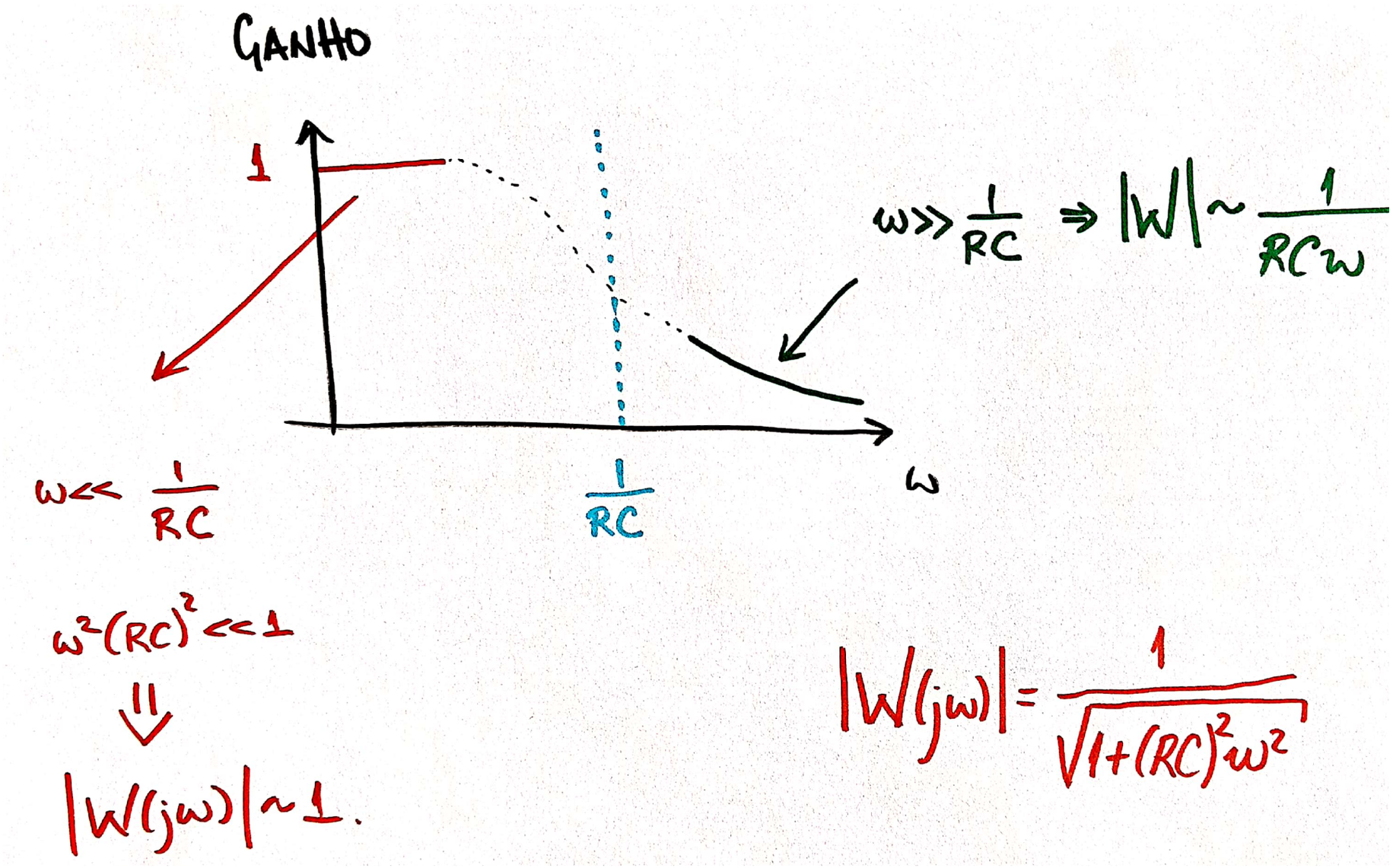

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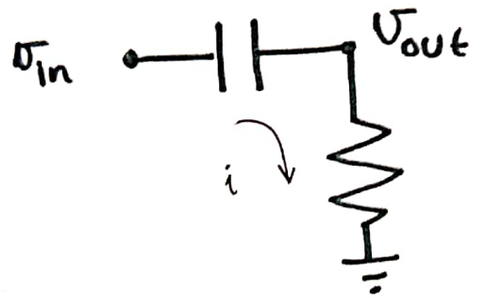

(1) $v_{in} - v_{out} = v_C = \frac{1}{C} q$

(2) $v_{out} = v_R = Ri \Rightarrow i = \frac{1}{R} v_{out}$

DERIVANDO (1)

$$\dot{v}_{in} - \dot{v}_{out} = \frac{1}{C} i \Rightarrow \tau = RC$$

USANDO (2)

$$\dot{v}_{in} - \dot{v}_{out} = \frac{1}{RC} v_{out}$$

$\frac{1}{\tau}$

TRANSF.

$$sV_{in} - sV_{out} = \frac{1}{\tau} V_{out}$$

$$V_{out} = \frac{\tau s}{1+\tau s} V_{in} \Rightarrow W(jw) = \frac{j\tau w}{1+j\tau w}$$

$W(s)$

GANHO

$$|W(jw)|^2 = \frac{j\tau w}{(1+j\tau w)} \cdot \frac{-j\tau w}{(1-j\tau w)}$$

$$= \frac{\tau^2 w^2}{1+\tau^2 w^2}$$

$$|W(jw)| = \frac{\tau w}{\sqrt{1+\tau^2 w^2}}$$

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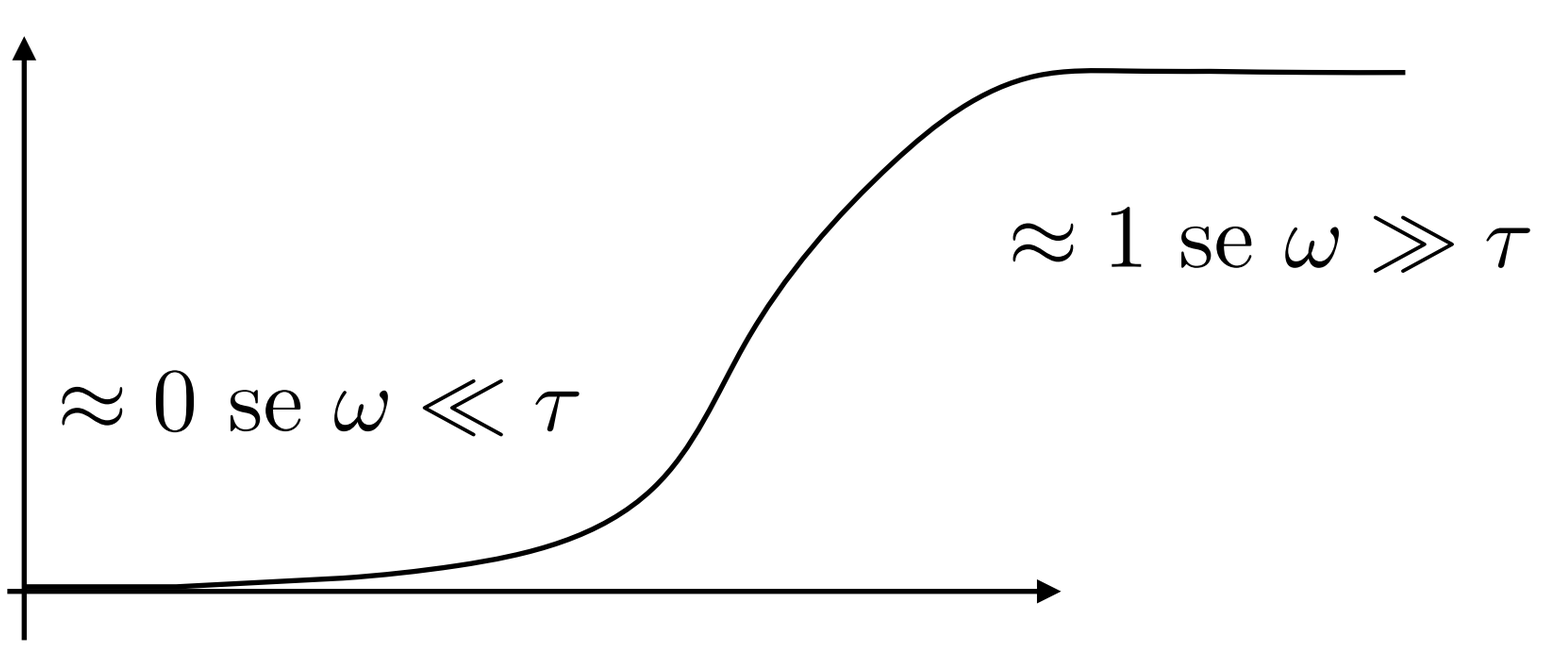
$$|W(j\omega)| = \frac{\tau\omega}{\sqrt{1+\tau^2\omega^2}}$$



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