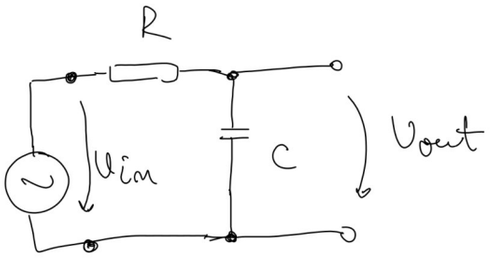
Laborator 2 electronică 1:

Determinați funcția de transfer a filtrului de mai jos.

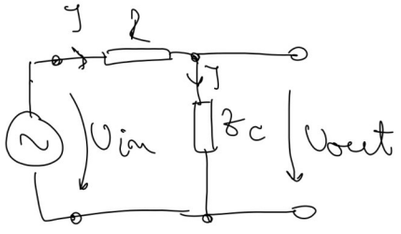


$u_{in} = A \sin \omega t$

frecvență, f, ν

$$\frac{A_{out}}{A_{in}} = ? = f(\nu) = \left| \frac{U_{out}}{U_{in}} \right|$$

schemă echivalentă



$$U_{in} = \gamma (R + Z_C)$$

$$U_{out} = \gamma \cdot Z_C$$

$$\frac{U_{out}}{U_{in}} = \frac{\gamma Z_C}{\gamma (R + Z_C)} = \frac{Z_C}{R + Z_C} = \frac{Z_C}{Z_C \left(1 + \frac{R}{Z_C}\right)}$$

$$\frac{U_{out}}{U_{in}} = \frac{1}{1 + \frac{R}{Z_C}} = \frac{1}{1 - \frac{R}{\frac{1}{j 2\pi f C}}} = \frac{1}{1 - \frac{1}{j} \cdot 2\pi f C R}$$

$$Z_C = -\frac{j}{\omega C} = j\left(-\frac{1}{2\pi f C}\right) \qquad \left[-\frac{1}{j} = \frac{j^2}{j} = j \right]$$

$$\boxed{\frac{U_{out}}{U_{in}} = \frac{1}{1 + j \cdot 2\pi f R C}}$$

$$\left| \frac{U_{out}}{U_{in}} \right|$$

$$\Delta\phi = \phi_{out} - \phi_{in} = 0 -$$

$$\left|\frac{U_{out}}{U_{in}}\right| = \frac{|1|}{|1 + j \cdot 2\pi f RC|} = \frac{1}{\sqrt{1^2 + (2\pi f RC)^2}} = \frac{1}{\sqrt{1 + (f \cdot 2\pi RC)^2}}$$

Frecventa de taiere → atenuare cu 3 dB

$$\left|\frac{U_{out}}{U_{in}}\right| = -3\,dB = 0.7$$

$$n\,[dB] = 10 \log_{10} \frac{P_{out}}{P_{in}} = 10 \log_{10} \frac{P}{P_{ref}}$$

$$= 10 \log_{10} \frac{\frac{U_{out}^2}{R}}{\frac{U_{in}^2}{R}} = 10 \log_{10} \left(\frac{U_{out}}{U_{in}}\right)^2 = 20 \log_{10} \frac{U_{out}}{U_{in}}$$

$U_{out} = U_{in} \Rightarrow n = 0\,dB$ → nici amplificare nici atenuare

$U_{out} = 2 U_{in} \Rightarrow n = +6.02\,dB$ amplificare (+dB)

$U_{out} = \frac{1}{2} U_{in} \Rightarrow n = -6.02\,dB$ atenuare (-dB)

$$20 \log_{10} \frac{V_{out}}{V_{in}} = -3$$

La $f = f_T$ $\left|\frac{V_{out}}{V_{in}}\right| = \frac{1}{\sqrt{2}}$

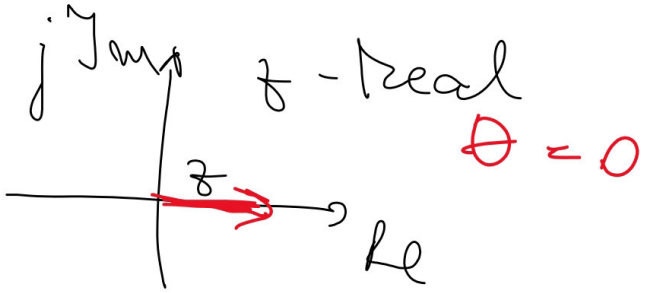
f_T - freq. de taière
(cutoff frequency)

$$\left|\frac{V_{out}}{V_{in}}\right| = \frac{1}{\sqrt{2}} = \frac{1}{\sqrt{1 + (2\pi f_T RC)^2}} = \frac{1}{\sqrt{2}}$$

$$1 + (2\pi f_T RC)^2 = 2$$

$$(2\pi f_T RC)^2 = 1$$

$$\boxed{f_T = \frac{1}{2\pi RC}}$$

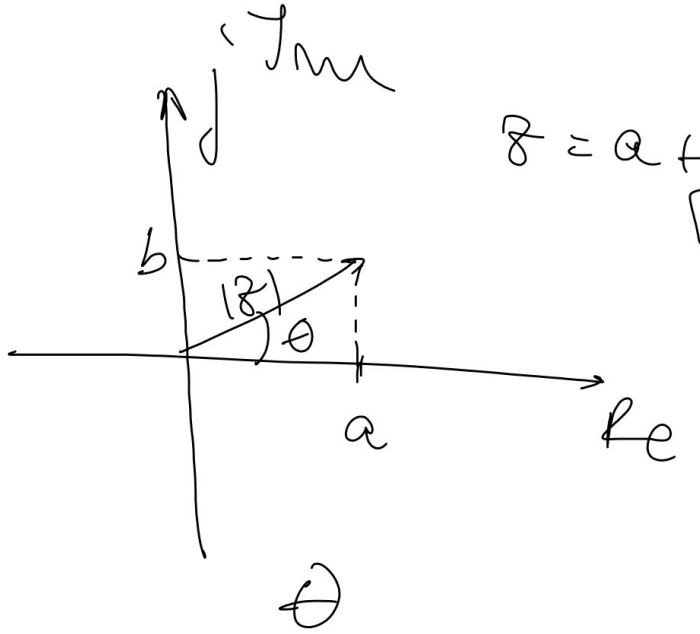


z - real

$\theta = 0$

$$z_3 = \frac{z_1}{z_2} = \frac{|z_1| e^{j\theta_1}}{|z_2| e^{j\theta_2}} =$$

$$= \left|\frac{z_1}{z_2}\right| e^{j(\theta_1 - \theta_2)}$$



$z = a + j \cdot b$

θ

$$\Delta\phi = 0 - \operatorname{arctg}\frac{Re}{Im} =$$

$$= 0 - \operatorname{arctg}\frac{1}{2\pi f RC} =$$

$$= -\operatorname{arctg}\frac{1}{2\pi RCf} = -\operatorname{arctg}\frac{f_T}{f} \quad \Delta\phi$$

$$f_T = \frac{1}{2\pi RC}$$

$$\left|\frac{U_{out}}{U_{in}}\right| = \frac{1}{\sqrt{1 + \left(\frac{f}{f_T}\right)^2}}$$