Seminar 1 electronică 4

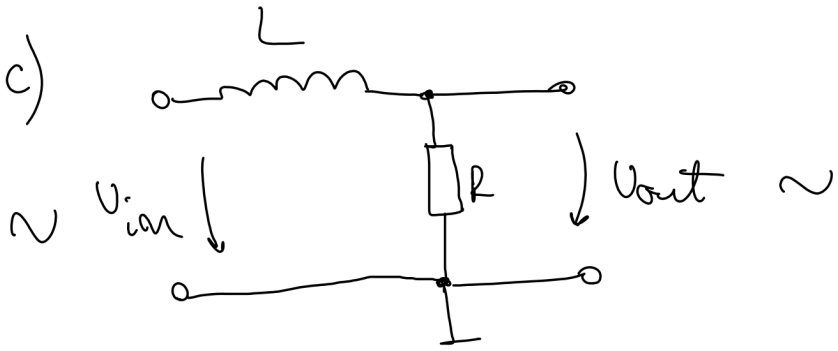
Filtre pasive:
("single pole filters")

(1.) Determinați:

- funcția de transfer
(+ reprezentare grafică)
- defazajul + repr. grafică
- tipul filtrului
- f_T (frecv. de tăiere), V_T
- panta filtrului

a) → vezi notițe Lab 2 electronică I

c)



pt. L, C ideale

$Z_L = j\omega L$, $\omega = 2\pi\nu$

$Z_C = -\frac{j}{\omega C}$

R ideal

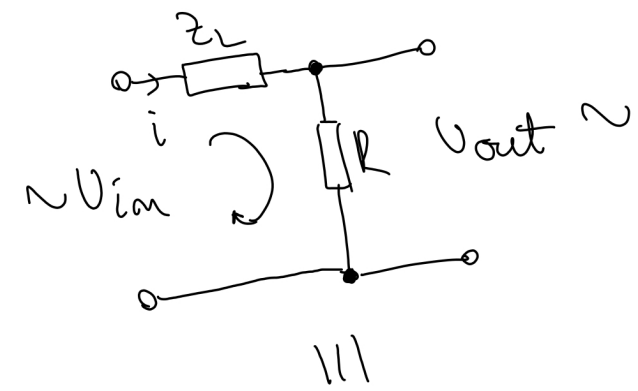
$Z_R = R$

$j = \sqrt{-1}$

Funcția de transfer $\left|\frac{V_{out}}{V_{in}}\right| = f(\nu)$

$\varphi = f(\nu)$

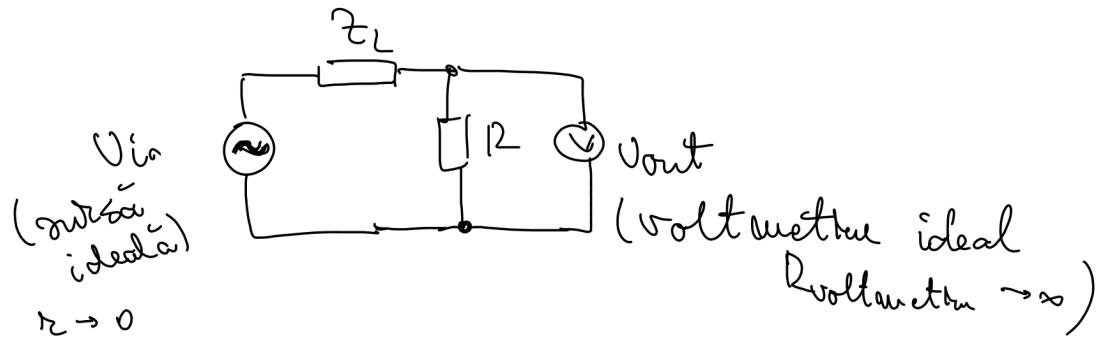
Schema echivalentă



$V_{in} = i(Z_L + R)$

$V_{out} = iR$

$$\frac{V_{out}}{V_{in}} = \frac{iR}{i(Z_L + R)}$$



$$\frac{V_{out}}{V_{in}} = \frac{R}{R\left(1 + \frac{Z_L}{R}\right)} \rightarrow Z_L = j\omega L$$

$$\boxed{\frac{V_{out}}{V_{in}} = \frac{1}{1 + j\cdot\frac{\omega L}{R}}}$$

$$\left|\frac{U_{out}}{U_{in}}\right| = \frac{1}{\sqrt{1+\frac{\omega^2 L^2}{R^2}}} = \frac{1}{\sqrt{1+\frac{4\pi^2 L^2}{R^2}\cdot \nu^2}}$$

- frecvența de tăiere → frecv. la care $\left|\frac{U_{out}}{U_{in}}\right| = \frac{1}{\sqrt{2}} = -3dB$.

$$\left[a\,(dB) = 10\log_{10}\frac{P_{out}}{P_{in}} = 20\log_{10}\frac{U_{out}}{U_{in}} = 20\log_{10}\frac{I_{out}}{I_{in}} \right]$$

$$\nu = \nu_T \Rightarrow \left|\frac{U_{out}}{U_{in}}\right| = \frac{1}{\sqrt{2}}$$

$$\frac{1}{\sqrt{1+\frac{4\pi^2 L^2}{R^2}\cdot \nu_T^2}} = \frac{1}{\sqrt{2}} \Rightarrow 1+\frac{4\pi^2 L^2}{R^2}\nu_T^2 = 2$$

$$\frac{4\pi^2 L^2}{R^2}\nu_T^2 = 1$$

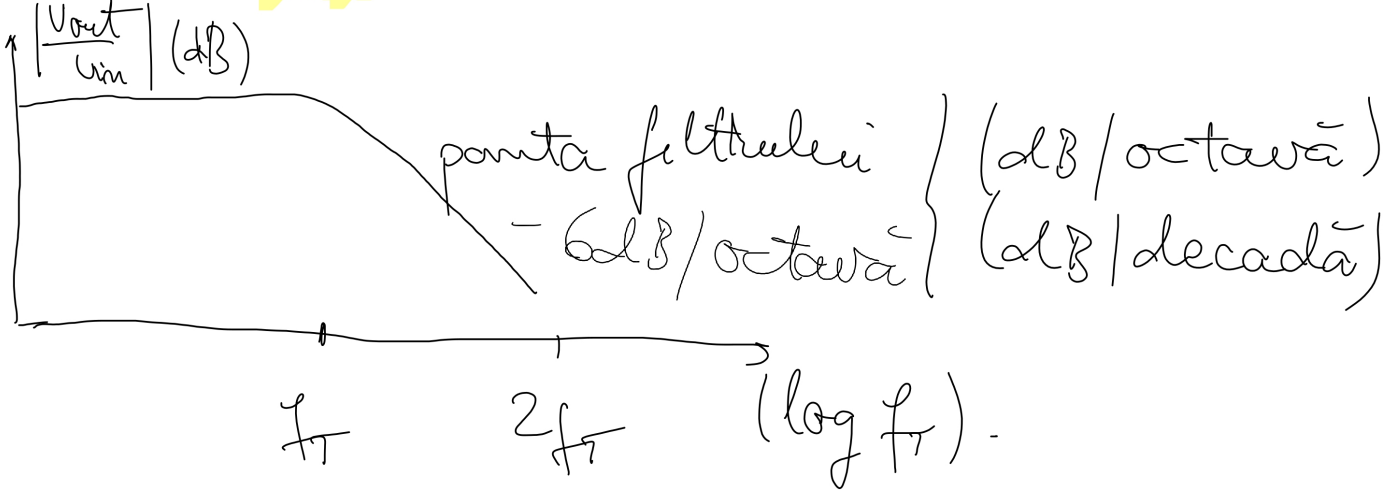
$$\nu_T^2 = \frac{R^2}{4\pi^2 L^2} \Rightarrow \boxed{\nu_T = \frac{R}{2\pi L}}$$

$$\boxed{\left|\frac{U_{out}}{U_{in}}\right| = \frac{1}{\sqrt{1+\left(\frac{\nu}{\nu_T}\right)^2}}}$$

Filtru trece-jos (FTJ)

(LPF)

"Low-pass filter"

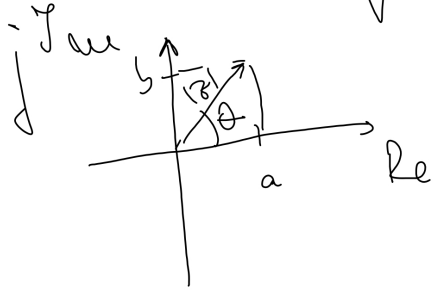


Vrem să proiectăm un filtru trece-jos cu $\nu_T = 50kHz$

$R = 1k\Omega$.

$$\nu_T = \frac{R}{2\pi L} \Rightarrow L = \frac{R}{2\pi \nu_T} = \frac{1000\,\Omega}{6.28\cdot 50000\,Hz} = 3.18\,mH$$

$$z = a + jb = |z| e^{j\theta}$$



$$\theta = \operatorname{arctg} \frac{Im\{z\}}{Re\{z\}}$$

$$z_1 = |z_1| e^{j\theta_1}$$

$$z_2 = |z_2| e^{j\theta_2}$$

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

defazajul

$\frac{|z_1|}{|z_2|}$ → funcția de transfer

$$\frac{U_{out}}{U_{in}} = \frac{1}{1 + j \cdot \frac{\omega L}{R}}$$

$$\theta_{out} = 0$$

$$\theta_{in} = \operatorname{arctg} \frac{\omega L}{R} = \operatorname{arctg} \frac{2\pi L}{R} \cdot \nu = \operatorname{arctg} \frac{\nu}{\nu_T}$$

($\frac{R}{2\pi L} = \frac{1}{\nu_T}$)

$$\varphi = 0 - \operatorname{arctg} \frac{\nu}{\nu_T}$$

$$\varphi = -\operatorname{arctg} \frac{\nu}{\nu_T}$$