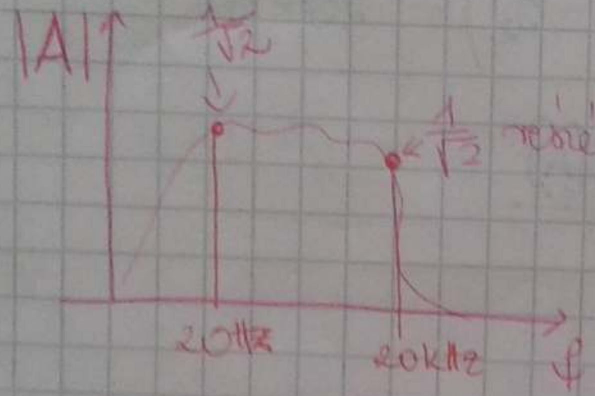
$$u_{ki} = 0{,}5\sqrt{2}\sin(200t - 86{,}2°) + 0{,}064\sqrt{2}\sin(400t - 102{,}07°)$$

u. azok lesznek

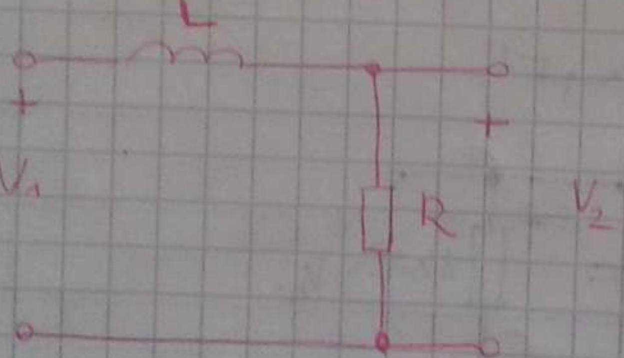
okt. 17. Bode diagram



20Hz-től 20kHz-ig hallunk

$\frac{1}{\sqrt{2}}$ része csökk. a jelszint

alsó és felső határfrekv. letörési pontok



Bode diagr. = frekvencia válasz fv. ábrázolása

egy gerjesztés hatására milyen frekvencia- és fázis- változás lesz a kimeneten

$$V_2 = V_1 \cdot \frac{R}{R + j\omega L} \longrightarrow \frac{V_2}{V_1} = \frac{R}{R + j\omega L} \left(= \frac{V_{ki}}{V_{be}} \right)$$

$$H(j\omega) = \frac{R}{R + j\omega L}$$

$$H(j\omega)=\frac{R}{R+j\omega L}=\frac{1}{1+j\omega\frac{L}{R}}\Bigg|_{\omega_0=\frac{R}{L}}=\frac{1}{1+j\frac{\omega}{\omega_0}}$$

$$H(j\omega)=\underbrace{|H(j\omega)|}_{\text{amplitúdó-menet}}\angle\underbrace{\varphi_H(j\omega)}_{\text{fázismenet}}$$

Bode - w: jelszint hogyan vált.? — külö. frekvenciákon a fáziseltolódást mutatja meg

$$|H(j\omega)|=\sqrt{H(j\omega)\cdot \underset{\text{konjugált}}{H^*(j\omega)}}=\sqrt{\frac{1}{1+j\frac{\omega}{\omega_0}}\cdot\frac{1}{1-j\frac{\omega}{\omega_0}}}=$$

$(a+b)\cdot(a-b)$

$(a+jb)(a-jb)=a^2+b^2$

$$=\sqrt{\frac{1}{1+\left(\frac{\omega}{\omega_0}\right)^2}}$$

$a^2 \ominus b^2$

$j^2=-1$

$$|H(j\omega)|\Big|_{\omega\to 0}\to 1$$

$$|H(j\omega)|\Big|_{\omega\to\infty}\to 0$$

$$|H(j\omega)|\Big|_{\omega=\omega_0}\to\frac{1}{\sqrt{2}}\approx 0{,}707$$

konjugált $(a+b)\cdot(a-b)$

$(a+jb)(a-jb)=a^2+b^2$!

$$= \sqrt{\frac{1}{1+\left(\frac{\omega}{\omega_0}\right)^2}}$$

$|H(j\omega)|\big|_{\omega\to 0} \to 1$

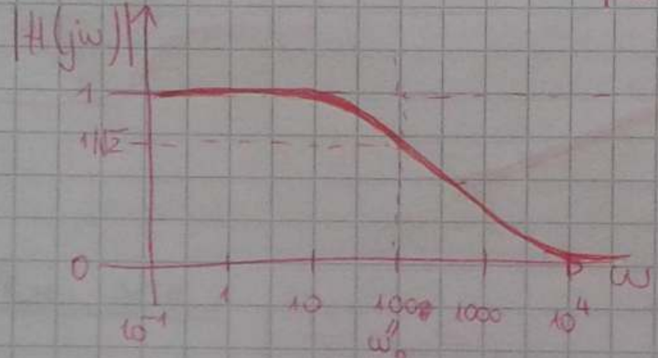
$a^2 - b^2$

$\downarrow$

$j^2=-1$

$|H(j\omega)|\big|_{\omega\to\infty} \to 0$

$|H(j\omega)|\big|_{\omega=\omega_0} \to \frac{1}{\sqrt{2}} \approx 0{,}707$



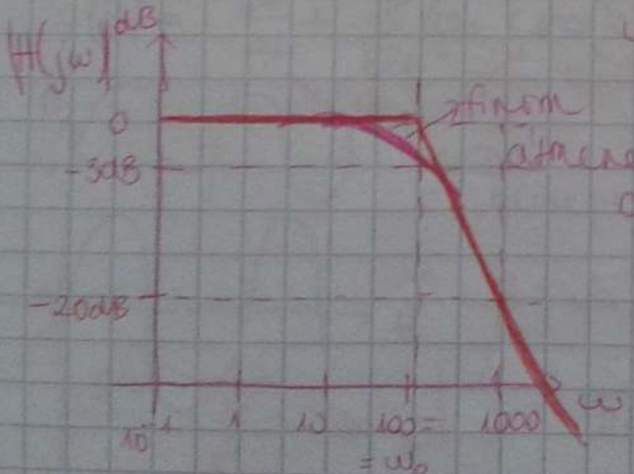
Bode diagr.
amplitúdó karakterisztikája

$$|H(j\omega)|^{dB} = 20\log_{10}|H(j\omega)| = 20\lg\left|\frac{V_{ki}}{V_{be}}\right|$$

$\omega\to 0 \Longrightarrow 0\text{ dB}$ (H) itt célszerű az ábrát nézni (diagr.)

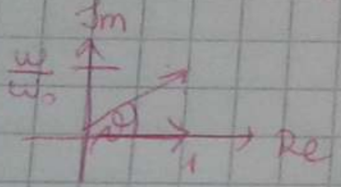
$\omega\to\infty \Longrightarrow -\infty\text{ dB}$

$\omega=\omega_0 \Longrightarrow -3\text{ dB}$



$$H(j\omega) = |H(j\omega)| \angle \vartheta_H(j\omega) = |H(j\omega)| e^{j\vartheta_H(j\omega)} =$$

$$= \frac{1}{\sqrt{1+\left(\frac{\omega}{\omega_0}\right)^2}} \cdot \frac{e^{j0}}{e^{j\,\mathrm{arctg}\frac{\omega}{\omega_0}}} = \frac{1}{\sqrt{1+\left(\frac{\omega}{\omega_0}\right)^2}} e^{-j\,\mathrm{arctg}\frac{\omega}{\omega_0}}$$



$\mathrm{arctg}\,\frac{\frac{\omega}{\omega_0}}{1}$

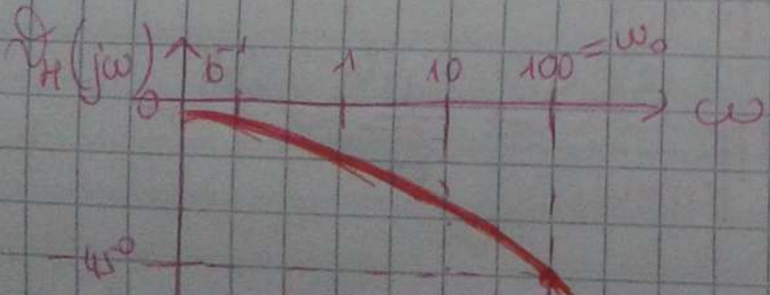
$\frac{1}{1+j\frac{\omega}{\omega_0}}$ fázisát vesszük

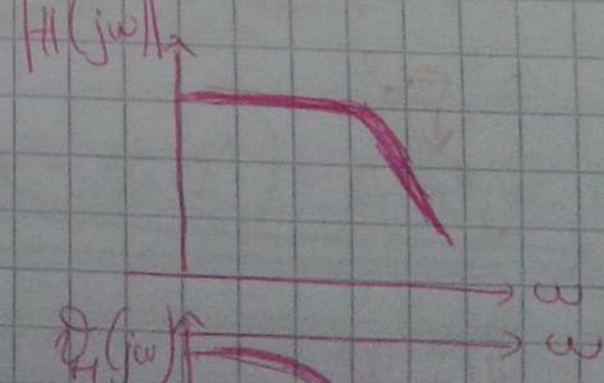
$$\vartheta_H(j\omega) = -\mathrm{arctg}\frac{\omega}{\omega_0}$$

$\vartheta_H(j\omega)\big|_{\omega\to 0} = 0°$ $\quad tg = \frac{\sin}{\cos}$ akkor 0, ha sin 0

$\vartheta_H(j\omega)\big|_{\omega\to\infty} = -90°$ $\quad tg = \frac{\sin}{\cos}$ ha cos 0

$\vartheta_H(j\omega)\big|_{\omega\to\omega_0} = -45°$

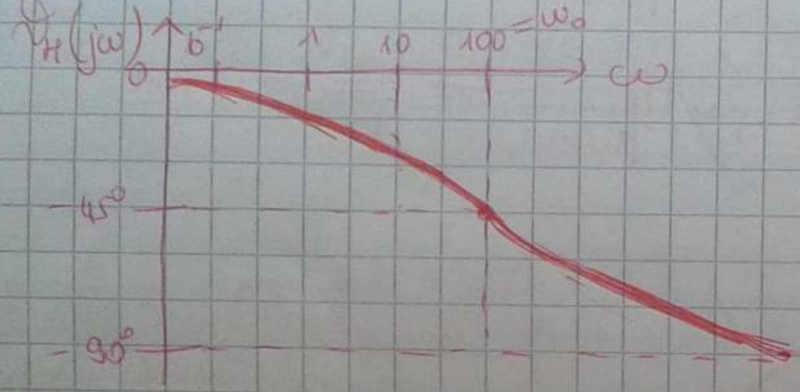


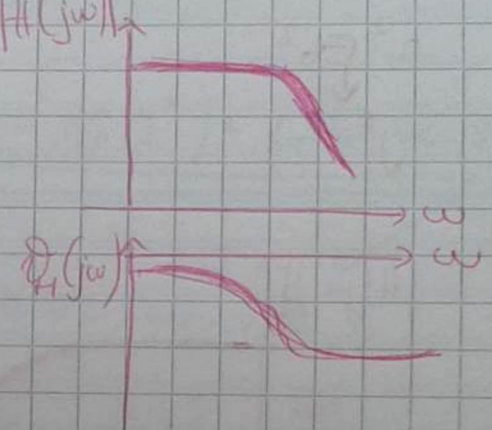


$$\vartheta_H(j\omega)\big|_{\omega\to 0} = 0^\circ \qquad tg = \frac{\sin}{\cos} \quad \text{arctg } 0, \text{ na } \sin 0$$

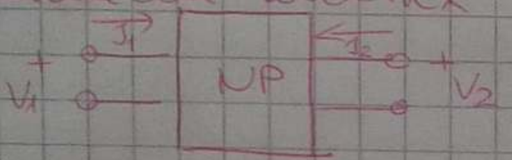
$$\vartheta_H(j\omega)\big|_{\omega\to \infty} = -90^\circ \qquad tg = \frac{\sin}{\cos} \quad \text{na } \cos 0$$

$$\vartheta_H(j\omega)\big|_{\omega\to \omega_0} = -45^\circ$$





Impedancija matrix



$$Z_{11} = \frac{V_1}{I_1}\Big|_{I_2=0}$$

$$Z_{12} = \frac{V_1}{I_2}\Big|_{I_1=0}$$

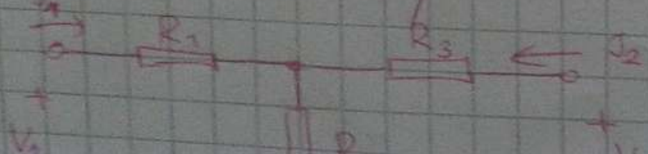
$$V_1 = Z_{11} I_1 + Z_{12} I_2$$

$$V_2 = Z_{21} I_1 + Z_{22} I_2$$

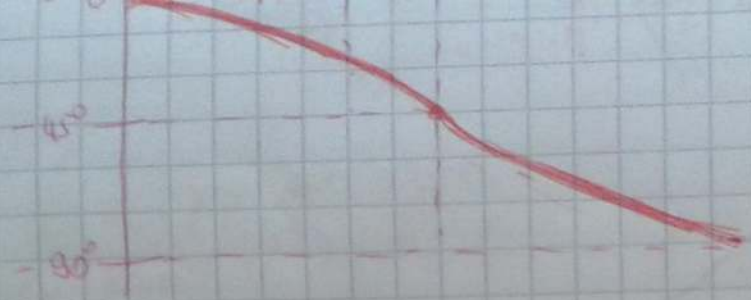
$$Z_{21} = \frac{V_2}{I_1}\Big|_{I_2=0}$$

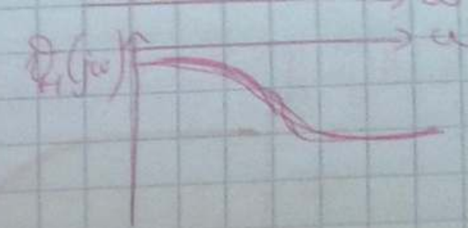
$$Z_{22} = \frac{V_2}{I_2}\Big|_{I_1=0}$$

$$\underline{\underline{Z}} = \begin{pmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{pmatrix}$$

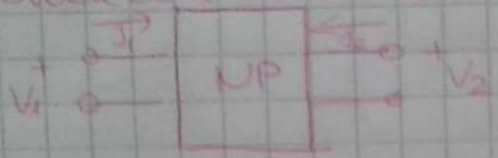


$$Z_{11} = R_1 + R_2$$





Impedancia matrix



$$V_1 = Z_{11} I_1 + Z_{12} I_2$$

$$V_2 = Z_{21} I_1 + Z_{22} I_2$$

$$Z_{11} = \frac{V_1}{I_1}\Big|_{I_2=0}$$

$$Z_{12} = \frac{V_1}{I_2}\Big|_{I_1=0}$$

$$Z_{21} = \frac{V_2}{I_1}\Big|_{I_2=0}$$

$$Z_{22} = \frac{V_2}{I_2}\Big|_{I_1=0}$$

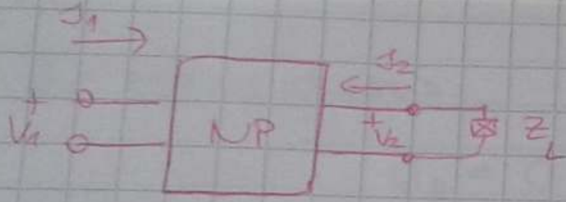
$$\underline{\underline{Z}} = \begin{pmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{pmatrix}$$

$$Z_{11} = R_1 + R_2$$

$$Z_{12} = \frac{V_1}{I_2}\Big|_{I_1=0} = \frac{V_1}{\frac{V_1}{R_2}} = R_2$$

$$Z_{22} = \frac{V_2}{I_2}\Big|_{I_1=0} = R_3 + R_2$$

$$Z_{21} = \frac{V_2}{I_1}\Big|_{I_2=0} = \frac{V_2}{\frac{V_2}{R_2}} = R_2$$

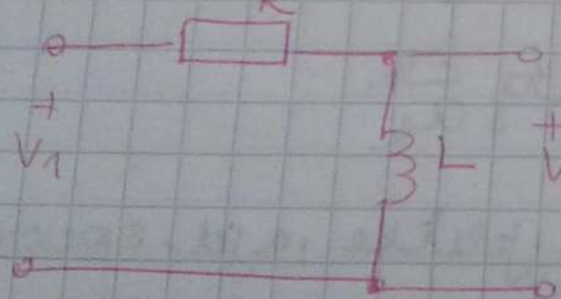


bemeneti impedancia adott lezáráshoz

$$Z_{be}\Big|_{Z_L} = \frac{V_1}{J_1}\Big|_{Z_L} = Z_{11} - \frac{Z_{12}Z_{21}}{Z_{22}+Z_L}$$

lezáráshoz tartozó frekvenciaválasz fv.

$$A_V\Big|_{Z_L} = \frac{V_2}{V_1} = \frac{Z_{12}\cdot Z_L}{Z_{11}\cdot Z_L + Z_{11}Z_{22} - Z_{12}\cdot Z_{21}}$$

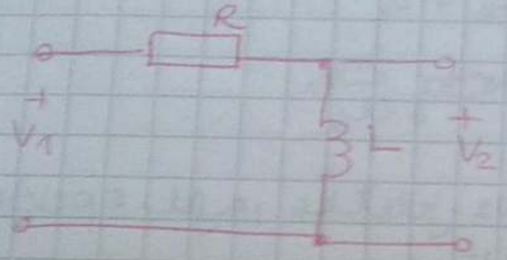


$$H(j\omega) = \frac{j\omega L}{R+j\omega L} = \frac{1}{1+\frac{R}{j\omega L}} =$$

$$= \frac{1}{1-j\frac{1}{\omega}\cdot\frac{R}{L}}\Bigg|_{\omega_0=\frac{R}{L}} = \frac{1}{1-j\cdot\frac{\omega_0}{\omega}}$$

$$|H(j\omega)| = \frac{1}{\sqrt{1+\left(\frac{\omega_0}{\omega}\right)^2}}$$

$$A_V\big|_{Z_L} \quad V_1 = \frac{\quad}{Z_{11} Z_L + Z_{11} Z_{22} - Z_{12} Z_{21}}$$



$$H(j\omega) = \frac{j\omega L}{R + j\omega L} = \frac{1}{1 + \frac{R}{j\omega L}} =$$

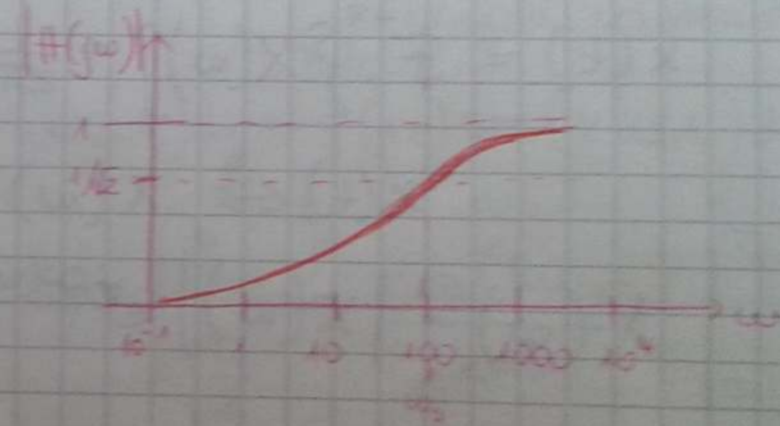
$$= \frac{1}{1 - j\frac{1}{\omega}\cdot\frac{R}{L}}\Bigg|_{\omega_0 = \frac{R}{L}} = \frac{1}{1 - j\frac{\omega_0}{\omega}}$$

$$|H(j\omega)| = \frac{1}{\sqrt{1 + \left(\frac{\omega_0}{\omega}\right)^2}}$$

$$|H(j\omega)|\Big|_{\omega \to 0} \to 0$$

$$|H(j\omega)|\Big|_{\omega \to \infty} \to 1$$

$$|H(j\omega)|\Big|_{\omega = \omega_0} \to \frac{1}{\sqrt{2}}$$



Fourier sor

nov. 7.

periodikus jelekre, diszkrét spektrumúak

$$x(t+T) = x(t) \quad \forall t$$

$$T_0 = \frac{1}{f_0}$$

$$x(t) = \frac{a_0}{2} + \sum_{k=1}^{\infty}\left(a_k \cos(k\omega_0 t) + b_k \sin(k\omega_0 t)\right)$$