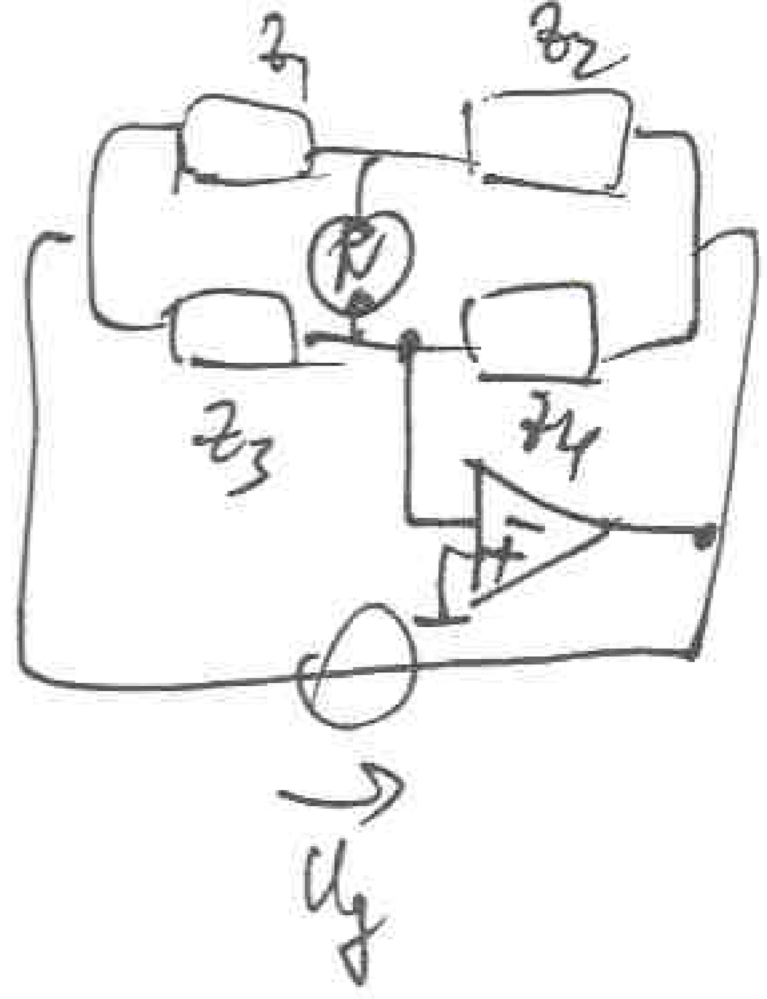
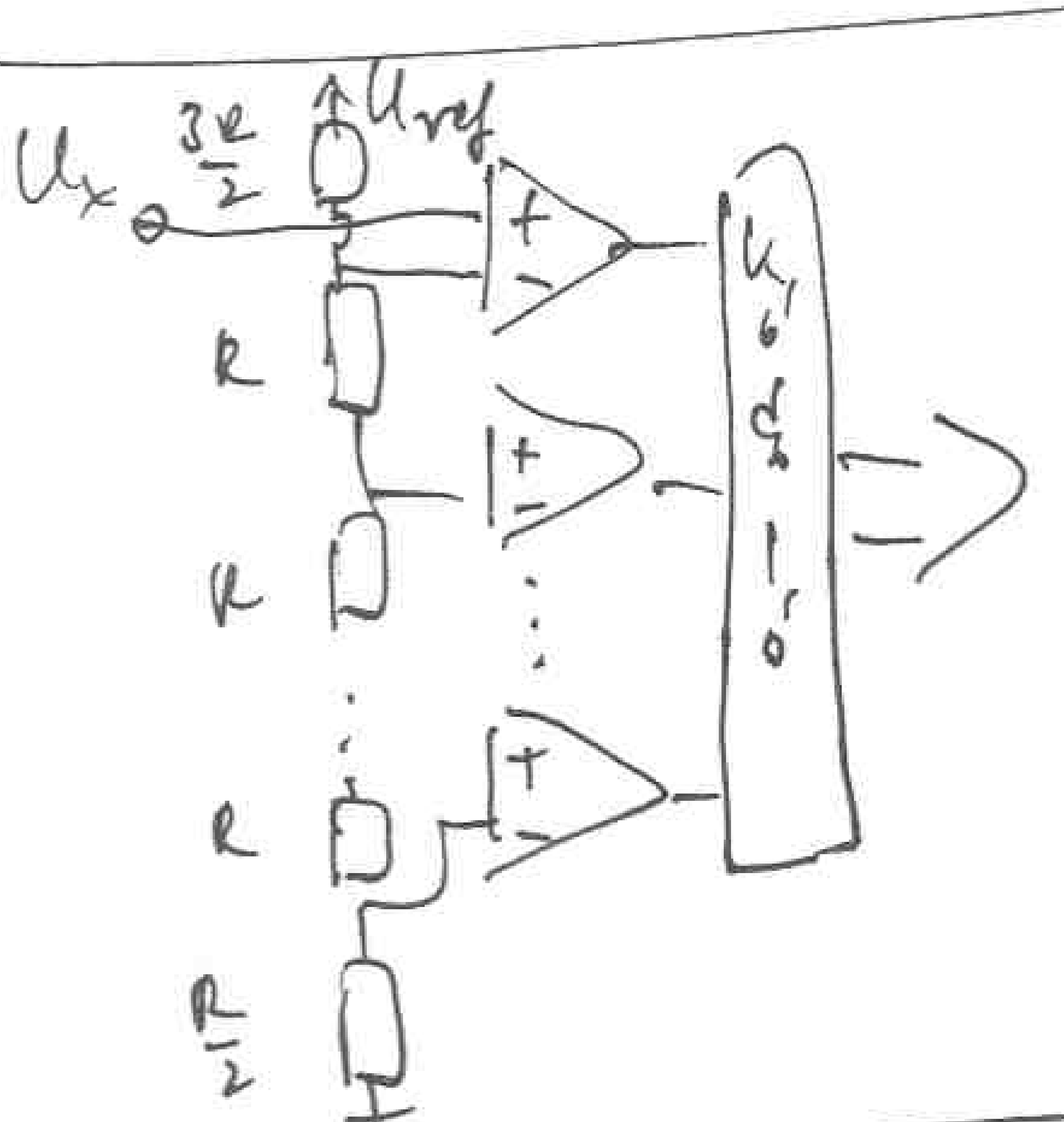
A1.)



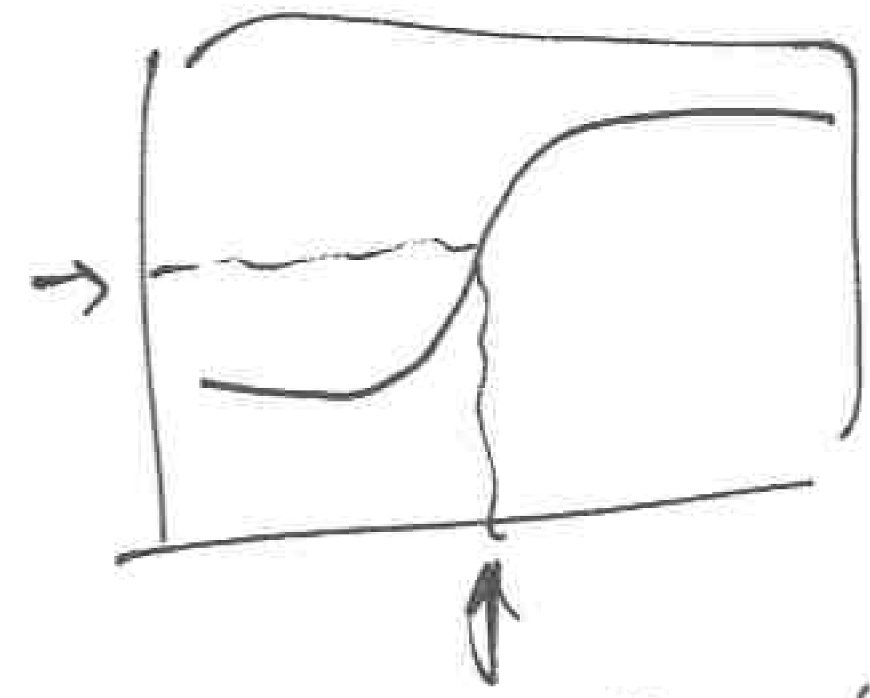
1

A2.)



1

A3.)



trigger esemény előtti jelrészlet megjelenítése

1

A4.) X(t) korlátos jelre, ha $X(f)=0$, ha $|f|>B$, $f_s>2B$ -vel mintavételezve X(t) helyreállítható

1

A5.) 4 vez. → R_s hatását eliminálja (1)

$R=\frac{U}{I}$, $\frac{\Delta R}{R}=\frac{\Delta U}{U}+\frac{\Delta I}{I}=2\cdot 0{,}5\%=1\%$ (1)

2

A6.) $q=\frac{4V}{2^{10}}$ $P_n=\frac{q^2}{12}$ $P_x=\frac{A^2}{2}$ $SNR_1=10\lg\frac{P_x}{P_n}=43{,}9\,dB\approx 44\,dB$ (1)

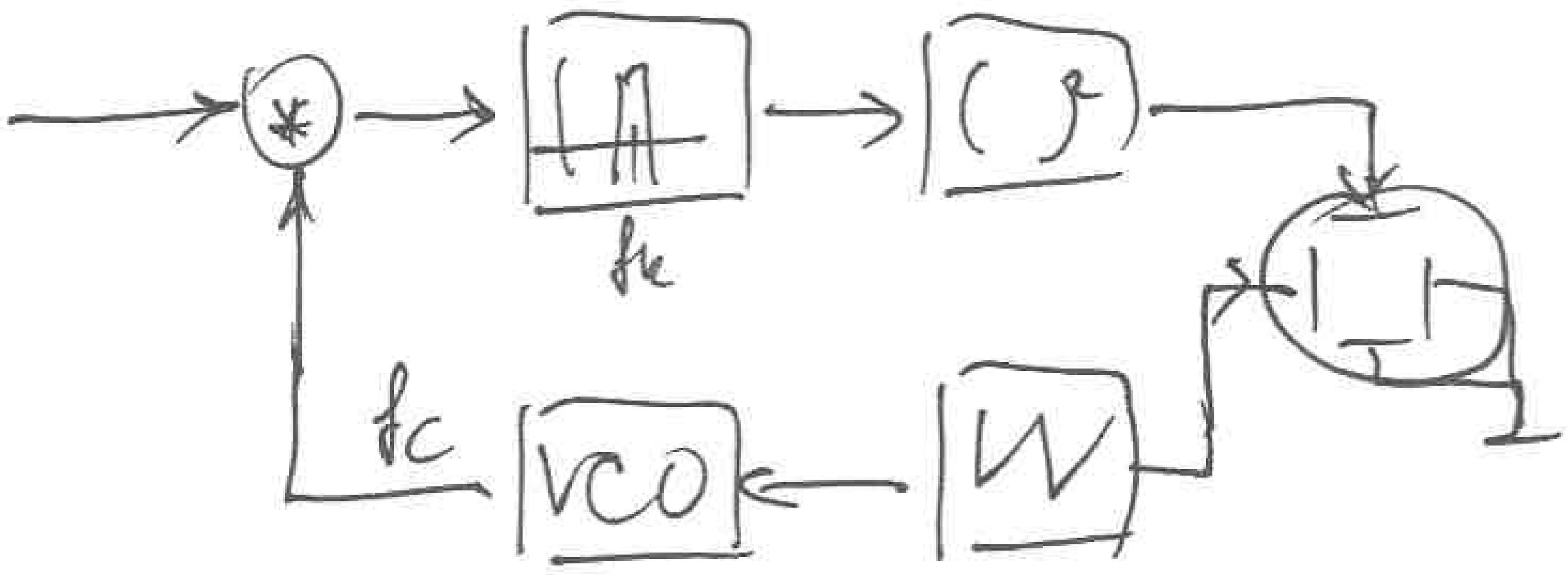
$P_{n1}=P_{n2} \Rightarrow SNR_2=SNR_1-3dB\approx 41\,dB$ (1)

2

A7.) $\Delta f=f\cdot h=0{,}5\,Hz$ $N=\frac{f_s}{\Delta f}=\frac{25000\,Hz}{0{,}5\,Hz}=50000$

1

A8.)



1

A I.

$$\varphi = 2\pi\frac{\tau}{T} = 2\pi\tau f = 0{,}3770 = 21{,}6^\circ$$ (1)

$$\Delta\varphi_1 = \varphi\left[\frac{\Delta\tau}{\tau} + \underbrace{\frac{\Delta f}{f}}_{\emptyset}\right] = \varphi\frac{1}{N} = \varphi\frac{1}{\tau f_0} = 2\pi\frac{\tau}{T}\frac{1}{\tau f_0} = 2\pi\frac{f}{f_0}$$ (2)

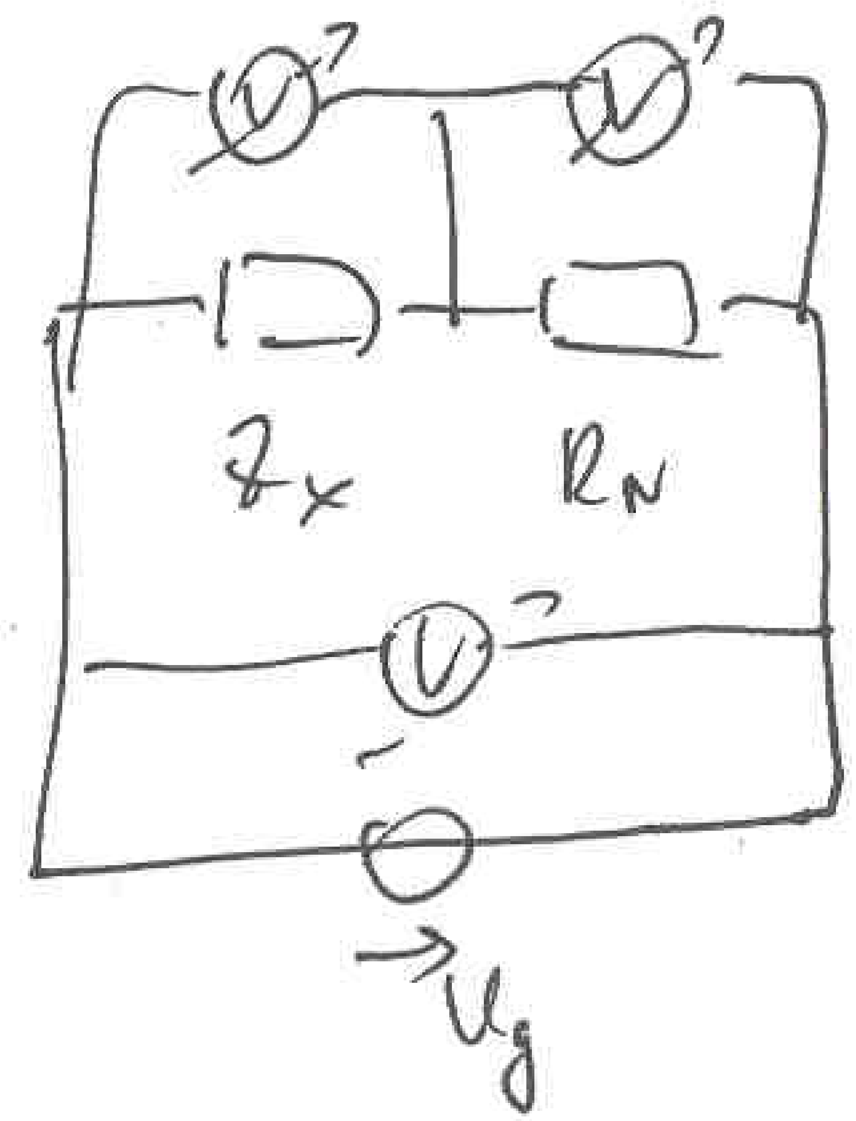
$$f_0 = \frac{2\pi f}{\Delta\varphi_1} = 314{,}159\ \text{kHz}$$

$$\Delta\varphi_2 = \varphi\left[\frac{\Delta\tau}{\tau} + \frac{\Delta f}{f}\right] = \varphi\left[\frac{\Delta\tau}{\tau} + \frac{\Delta T}{T}\right] = \varphi\left[\frac{1}{\tau f_0} + \frac{1}{T f_0}\right] = 2\pi f\tau\left[\frac{1}{\tau f_0} + \frac{f}{f_0}\right] \cong 3{,}33\cdot 10^{-5} \cong 0{,}001908^\circ$$ (2)

ho nem snažnuj

(5)

A II.



$$|Z| = R_N\frac{U_Z}{U_N} = 4{,}124\ \Omega$$ (1)

$$\cos\varphi = \frac{U_g^2 - U_Z^2 - U_N^2}{2U_Z U_N} = 0{,}9698$$ (1)

$$\varphi = 0{,}2463 \cong 14{,}11^\circ$$

$$Z = |Z|e^{j\varphi} = |Z|[\cos\varphi + j\sin\varphi] = R + j\omega L$$

$$R = |Z|\cos\varphi \cong 4\ \Omega$$ (1)

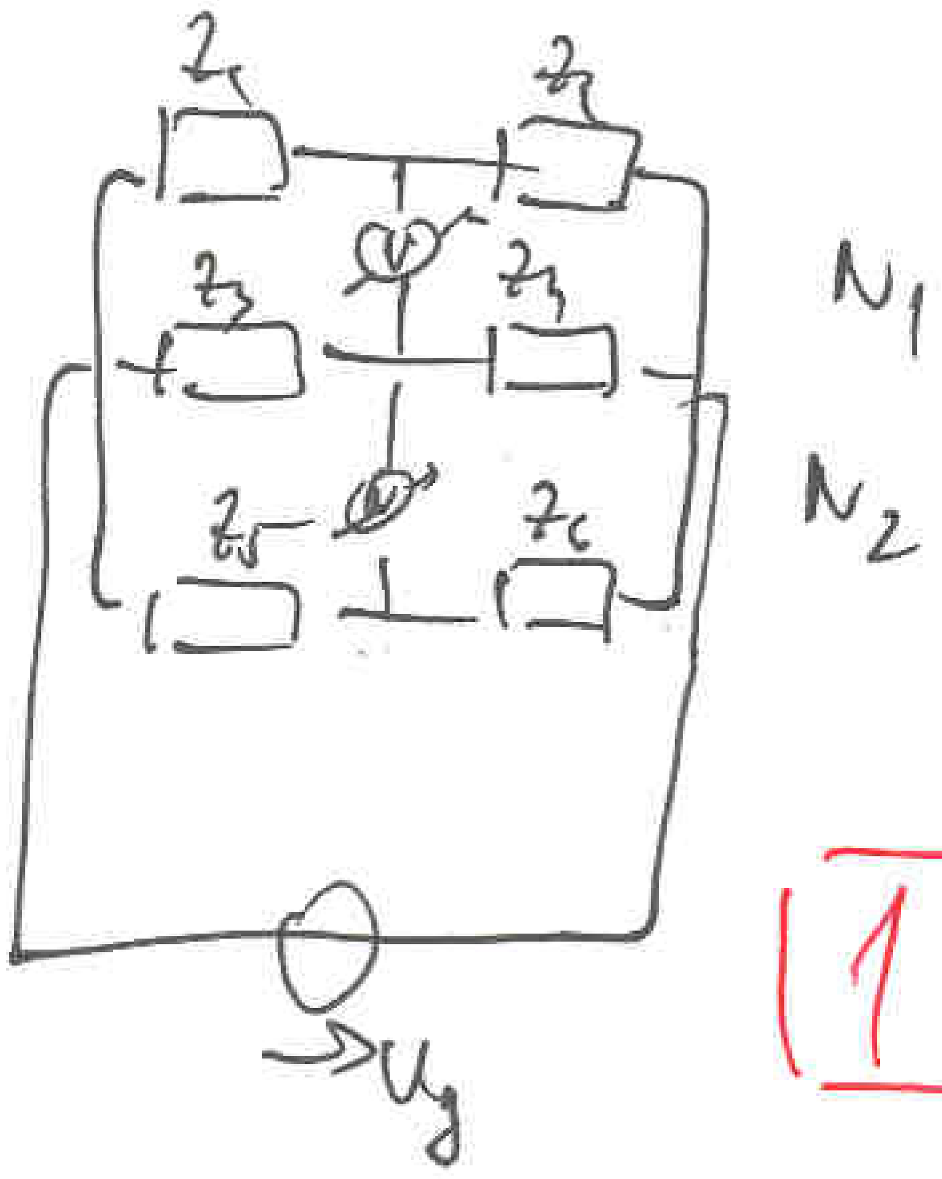
$$\omega = 2\pi f \cong 1000\ \frac{1}{s}$$

$$L = \frac{|Z|\sin\varphi}{\omega} \cong 1\ \text{mH}$$ (1)

$$P = \frac{U_g^2 - U_Z^2 - U_N^2}{2R_N} \cong 203\ \mu W$$ (1)

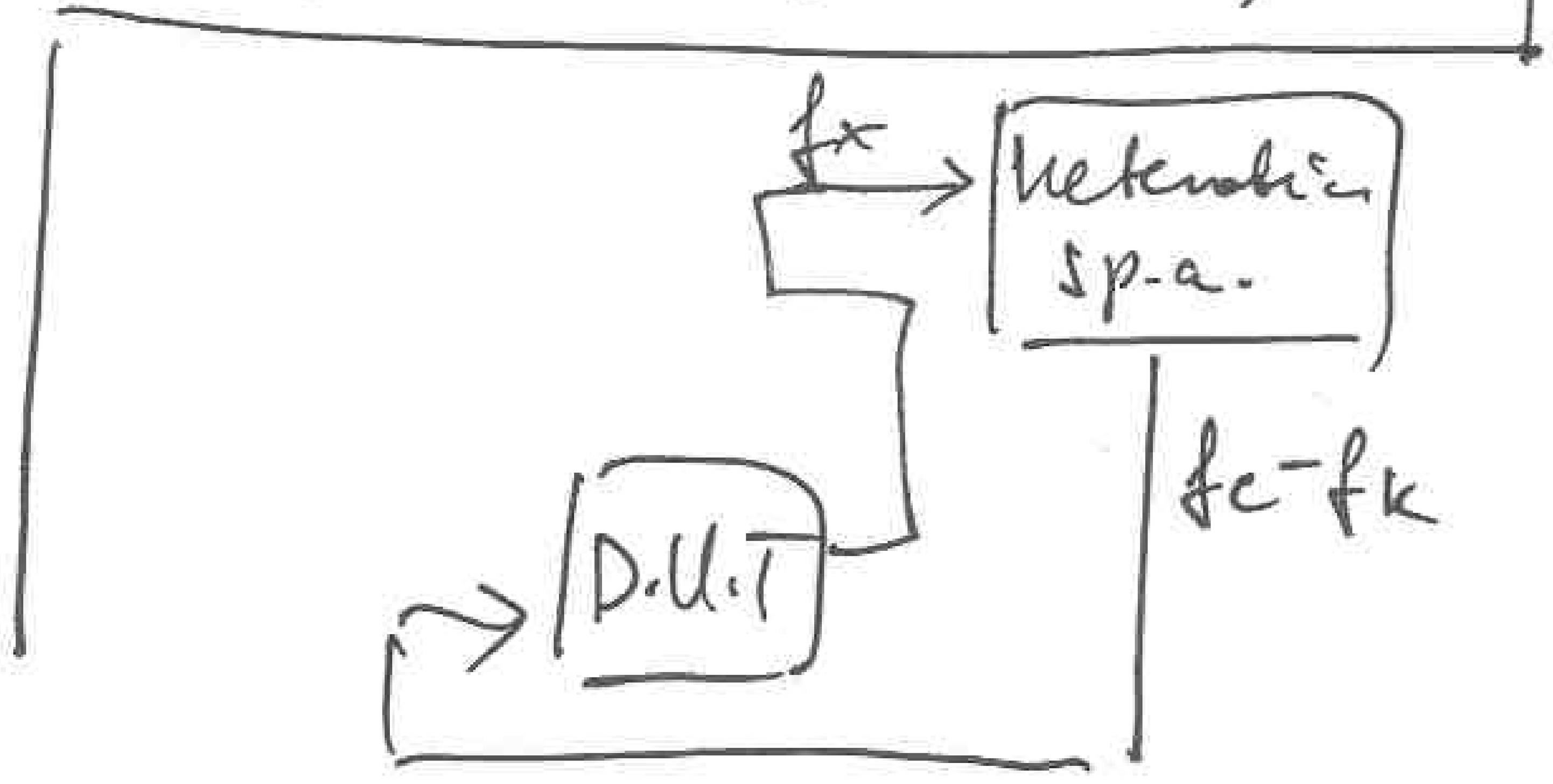
(5)

B1)



[1]

Kiegyenlítés: 1, N_2 2, N_1

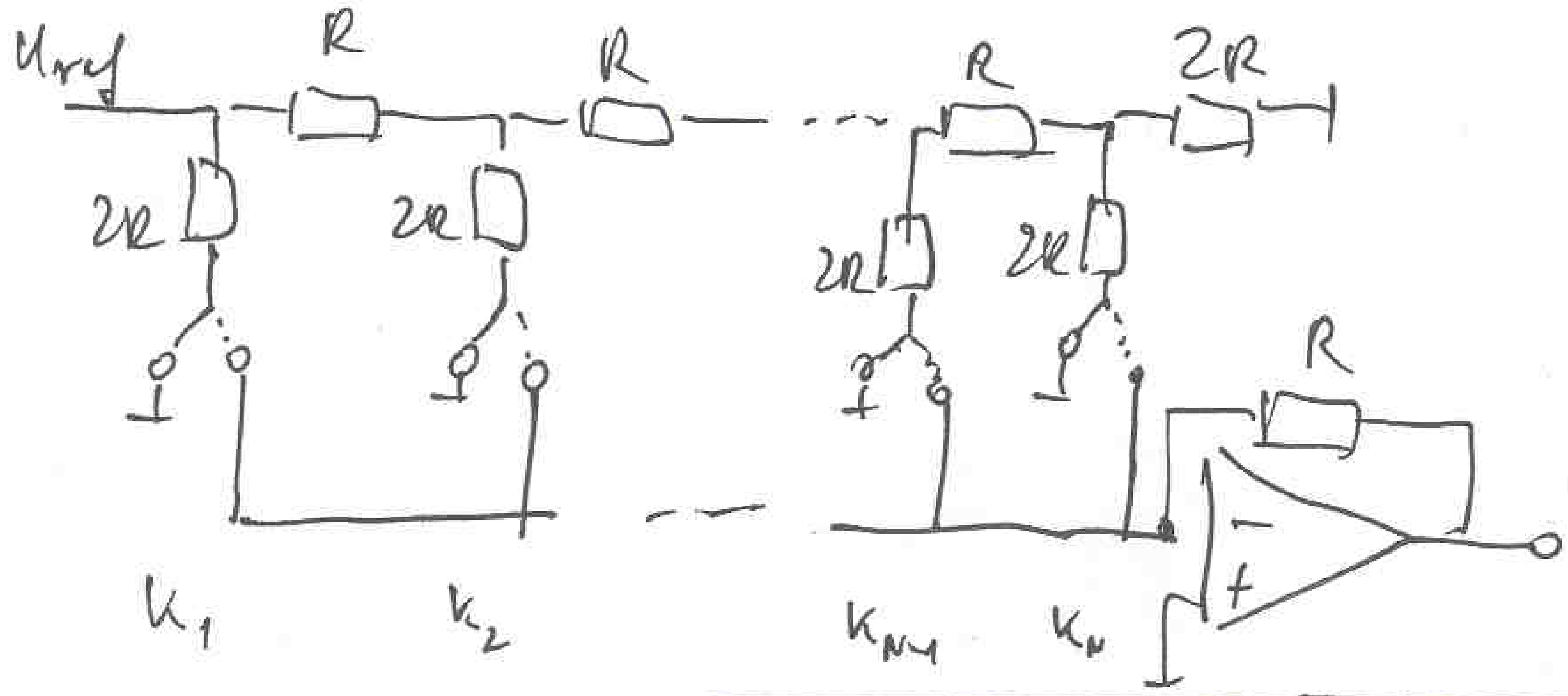


[1]

B8) több módon ∃ pl.

[1]

B2)

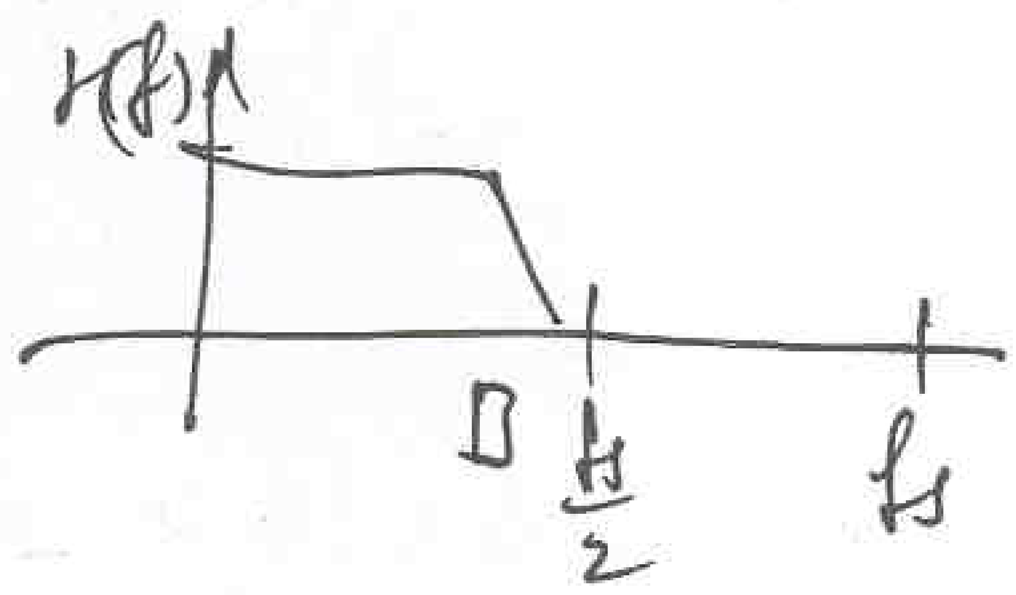


$$U_{ki} = -\sum_{i=1}^{N} U_r \frac{k_i}{2^i}$$

[1]

B3) Zoomolásra, azon jelrészlet kinagyítására [1]

B4) Mintavételi tétel feltételeinek biztosítására



$B < \frac{f_s}{2}$

[1]

B5) 3 vez → R_s hibát okoz $\Delta R = 2R_s$ $h_r = \frac{2R_s}{R_x} = 2\%$ (1) $h_v = \frac{\Delta R}{R} = \frac{\Delta U}{U} + \frac{\Delta I}{I} = 2\%$

$h_{ö} = h_r + h_v = 4\%$ (1)

[2]

B6) $q = \frac{4V}{2^{12}}$ $P_n = \frac{q^2}{12}$ $P_x = \frac{A^2}{2}$ $SNR_1 = 10\lg\frac{P_x}{P_n} \approx 68\,dB$ (1)

$P_n' = \frac{B}{f_{s,2}/2} \cdot P_n = \frac{P_n}{4}$ $SNR_2 = SNR_1 + 6\,dB = 74\,dB$ (1)

[2]

B7) $\Delta f = \frac{f_s}{N} = \frac{48000\,Hz}{2000} = 24\,Hz$ $f_x = f_m \pm \frac{\Delta f}{2} = 420 .. 444\,Hz$ [1]

B I.

$\varphi = 2\pi \frac{\tau}{T} = 2\pi \tau f = 0,2513 = 14,4^\circ$ (1) $t_m = 1\,sec \Rightarrow n = $ ~~20~~ 50 ha nem adunk

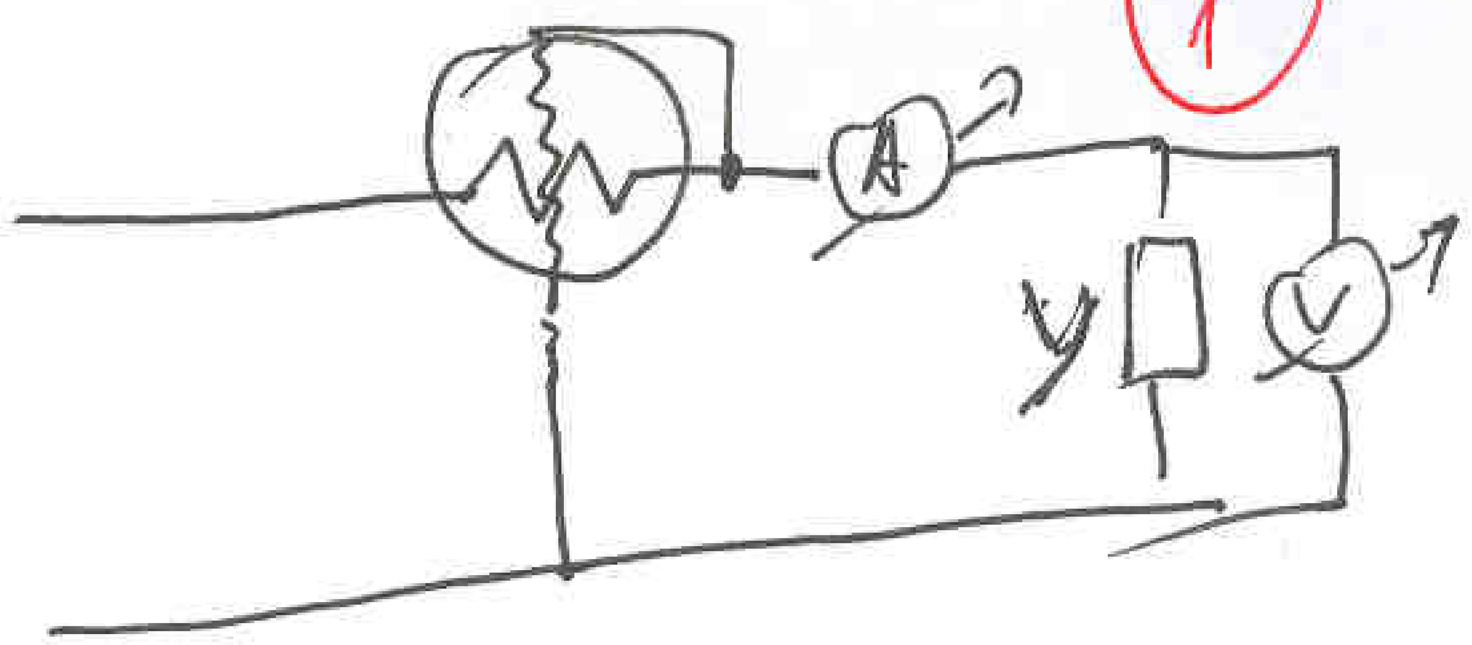
$\Delta\varphi|_\tau = \varphi \frac{1}{\sqrt{n}} \frac{1}{N} = \varphi \frac{1}{\sqrt{n}} \frac{1}{\tau f_0} = \frac{1}{\sqrt{n}} 2\pi \tau f \frac{1}{\tau f_0} = \frac{1}{\sqrt{n}} 2\pi \frac{f}{f} =$ ~~7,02~~ 4,44 $\cdot 10^{-5}$ (2)

[5]

$\Delta\varphi|_T = \varphi \frac{1}{t_m f_0} = 2\pi f \tau \frac{1}{t_m f_0} \cong 2,5 \cdot 10^{-7}$ $\Delta\varphi_{rel} = \sqrt{(\Delta\varphi_\tau)^2 + (\Delta\varphi_T)^2} \cong$ ~~7,02~~ 4,44 $\cdot 10^{-5} = 0,00$ ~~402~~ 255 $^\circ$

(áll. kapuidő) (1) (1)

B II.



(1)

$P = U \cdot I \cdot \cos\varphi$

$|Y| = \frac{I}{U} = 5,239 \cdot 10^{-5}\,S = 52,39\,\mu S$ $\cos\varphi = \frac{P}{U \cdot I} = 0,9561$ (1)

19088 kΩ

$\varphi = 0,2972 \cong 17,03^\circ$

$Y = |Y| e^{j\varphi} = |Y|[\cos\varphi + j\sin\varphi] = G + j\omega C$

$\omega = 2\pi f$

(1) $G = |Y| \cos\varphi \cong 0,05\,mS \Rightarrow R = 19962\,\Omega \approx 20\,k\Omega$

(1) $C = \frac{|Y| \sin\varphi}{\omega} = 48,8\,nF$

$\Delta P = P_V = \frac{U^2}{R_V} = 0,2645\,W$

$\frac{\Delta P}{P} \approx 10\%$ (1)

[5]