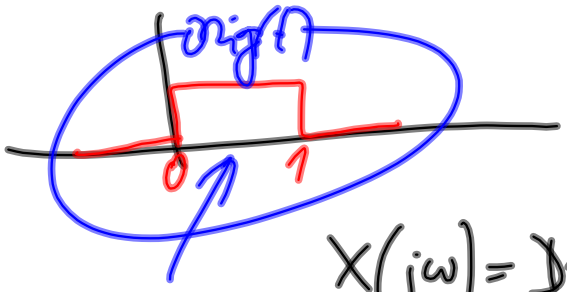
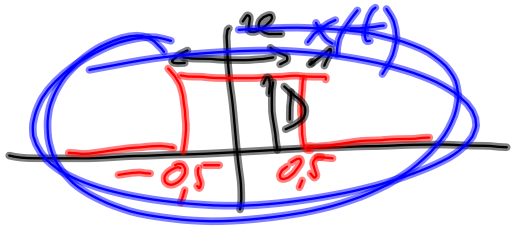




$$X(j\omega) = 1 \cdot 1 \cdot \mathrm{sinc}\left(\frac{1}{2}\omega\right) = 1 \cdot 1 \cdot \mathrm{sinc}(0{,}5\omega) = \mathrm{sinc}(0{,}5\omega)$$

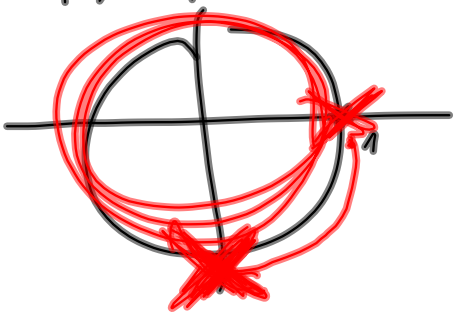
$$orig(t) = x(t - 0{,}5)$$

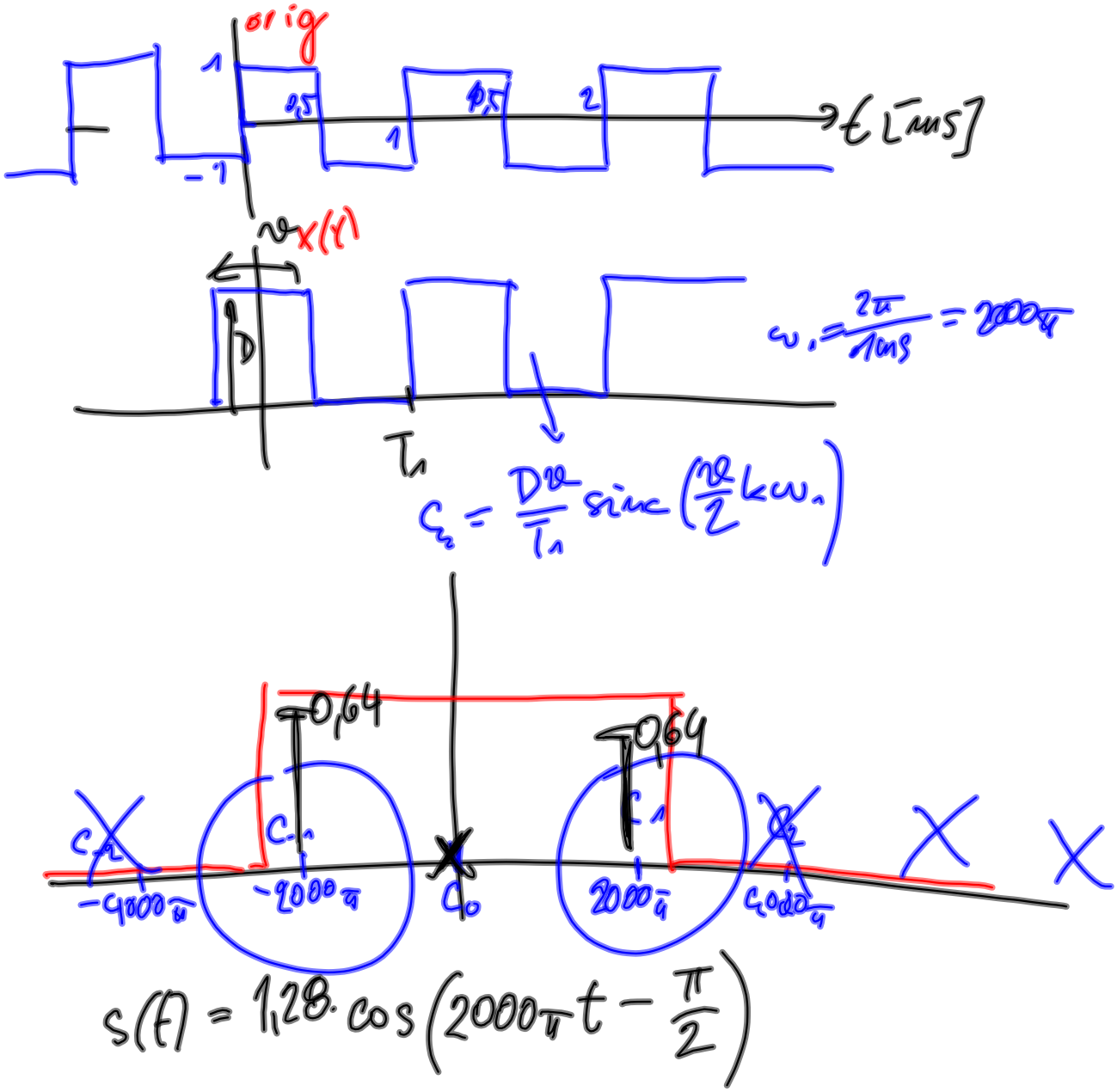
$$ORIG(j\omega) = X(j\omega) \cdot e^{j\omega \cdot 0{,}5} = \mathrm{sinc}(0{,}5\omega) \cdot e^{j\omega 0{,}5} =$$

$$= \mathrm{sinc}\left(\frac{1}{2}\pi\right) \cdot e^{j\frac{1}{2}\pi} =$$

$0{,}05$

$$-0{,}05j$$




orig
1
0,5
0,5
2
1
-1
t [ms]
x(t)
D
T_n
$\omega_1 = \frac{2\pi}{1ms} = 2000\pi$
$c_n = \frac{D\alpha}{T_n} \mathrm{sinc}\left(\frac{n\alpha}{2} k\omega_1\right)$
0,64
0,64
c_{-2}
c_{-1}
c_0
c_1
c_2
-4000π
-2000π
2000π
4000π
$s(t) = 1{,}28 \cdot \cos\left(2000\pi t - \frac{\pi}{2}\right)$

$N=4 \quad \tilde{x}[n]=[1\ 0\ -1\ 0]\,|\,1\ 0\ -1\ 0]\ldots$

$$\tilde{X}[k]=\sum_{n=0}^{\tilde{N}-1}\tilde{x}[n]\,e^{-j\frac{2\pi}{\tilde{N}}kn} \qquad \frac{2\pi}{N}$$

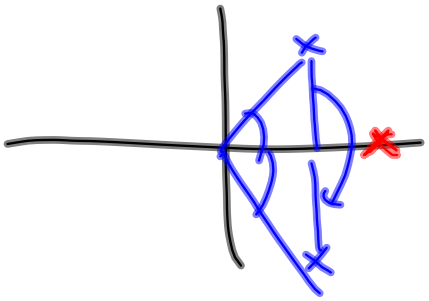
$e^{-j\frac{2\pi}{N}kn}=e^{-j\frac{2\pi}{4}kn}=e^{-j\frac{\pi}{2}kn}$

výstup = ~~konst~~ ~~součet~~ $\sum_{n=0}^{N-1}$ $\tilde{x}[n]$ vstup $e^{\pm j}$ frekvence čas

n	0	1	2	3	
$x[n]$	1	0	−1	0	
$k=0$, $e^{-j\frac{\pi}{2}0n}$	1	1	1	1	$\tilde{X}[0]=0$
$k=1$, $e^{-j\frac{\pi}{2}1n}=e^{-j\frac{\pi}{2}n}$	$e^{-j\frac{\pi}{2}0}$	$e^{-j\frac{\pi}{2}1}$	$e^{-j\frac{\pi}{2}2}$	$e^{-j\frac{\pi}{2}3}$	$\tilde{X}[1]=2$
$k=2$, $e^{-j\frac{\pi}{2}2n}=e^{-j\pi n}$	1	−1	1	−1	$\tilde{X}[2]=0$
$k=3$, $e^{-j\frac{\pi}{2}3n}$	1	j	−1	$-j$	$\tilde{X}[3]=2$

$$\tilde{X}[k]=\tilde{X}^*[N-k]$$

$$\tilde{X}[3]=\tilde{X}^*[4-3]=\tilde{X}^*[1]=2^*=2$$

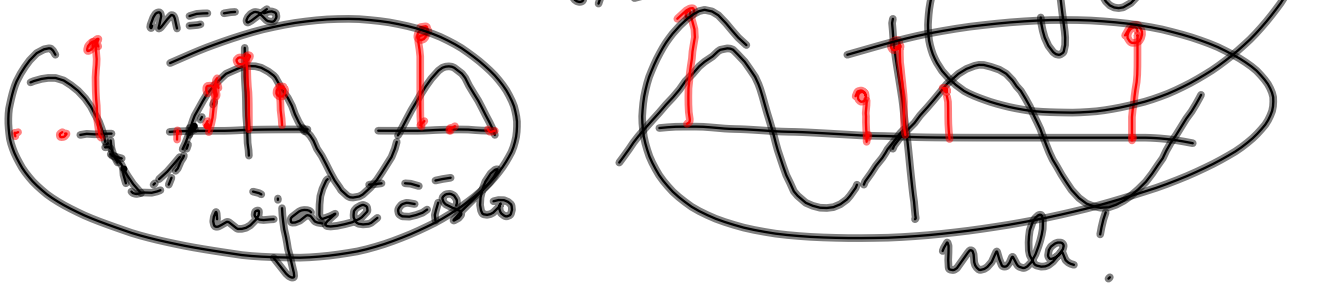


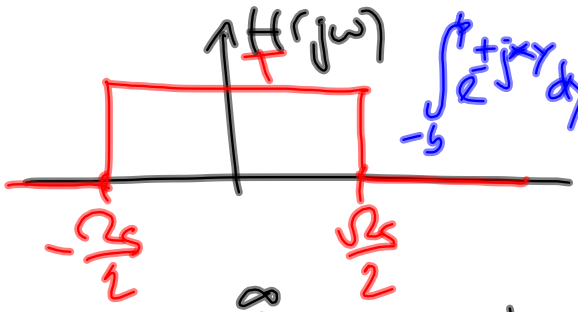
$$\tilde{X}(e^{j\omega}) = \sum_{n=-\infty}^{\infty} x[n] e^{-j\omega n} \qquad x[n] = x[-n]$$

$$e^{-j\alpha} = \cos\alpha - j\sin\alpha$$

$$\sum_{n=-\infty}^{\infty} x[n](\cos\omega n - j\sin\omega n) =$$

$$= \sum_{n=-\infty}^{\infty} x[n]\cos(\omega n) - j\sum_{n=-\infty}^{\infty} x[n]\sin(\omega n) =$$





$\int_{-b}^{b} e^{\pm jxy}\,dy = 2b\,\mathrm{sinc}(bx)$

imp. odezva ?

$$h(t) = \mathcal{F}^{-1}\left(H(j\omega)\right) =$$

$$= \frac{1}{2\pi}\int_{-\infty}^{\infty} H(j\omega)\,e^{\pm j\omega t}\,d\omega = \frac{1}{2\pi}\int_{-\frac{\Omega_s}{2}}^{\frac{\Omega_s}{2}} T\,e^{\pm j\omega t}\,d\omega =$$

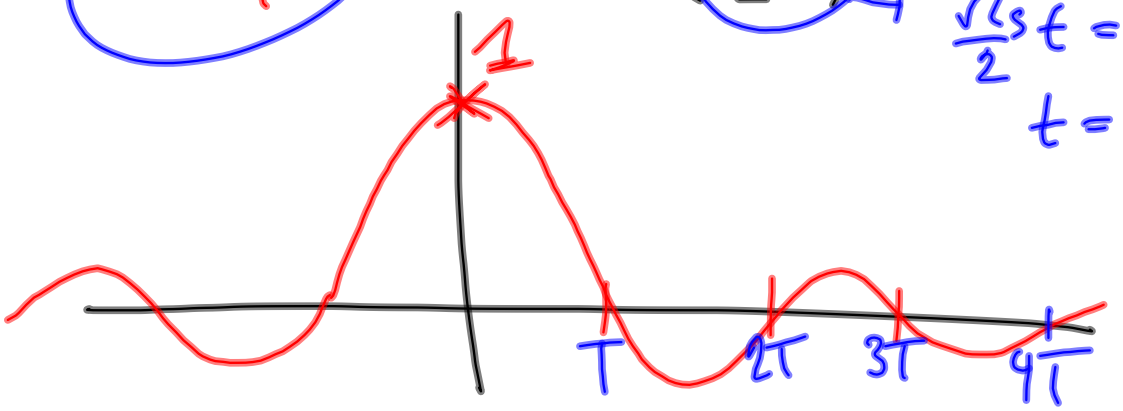
$$= \frac{T}{2\pi}\cdot 2\cdot\frac{\Omega_s}{2}\,\mathrm{sinc}\left(\frac{\Omega_s}{2}t\right) = \frac{T}{2\pi}\cdot\frac{2\pi}{T}\,\mathrm{sinc}\left(\frac{\Omega_s}{2}t\right) =$$

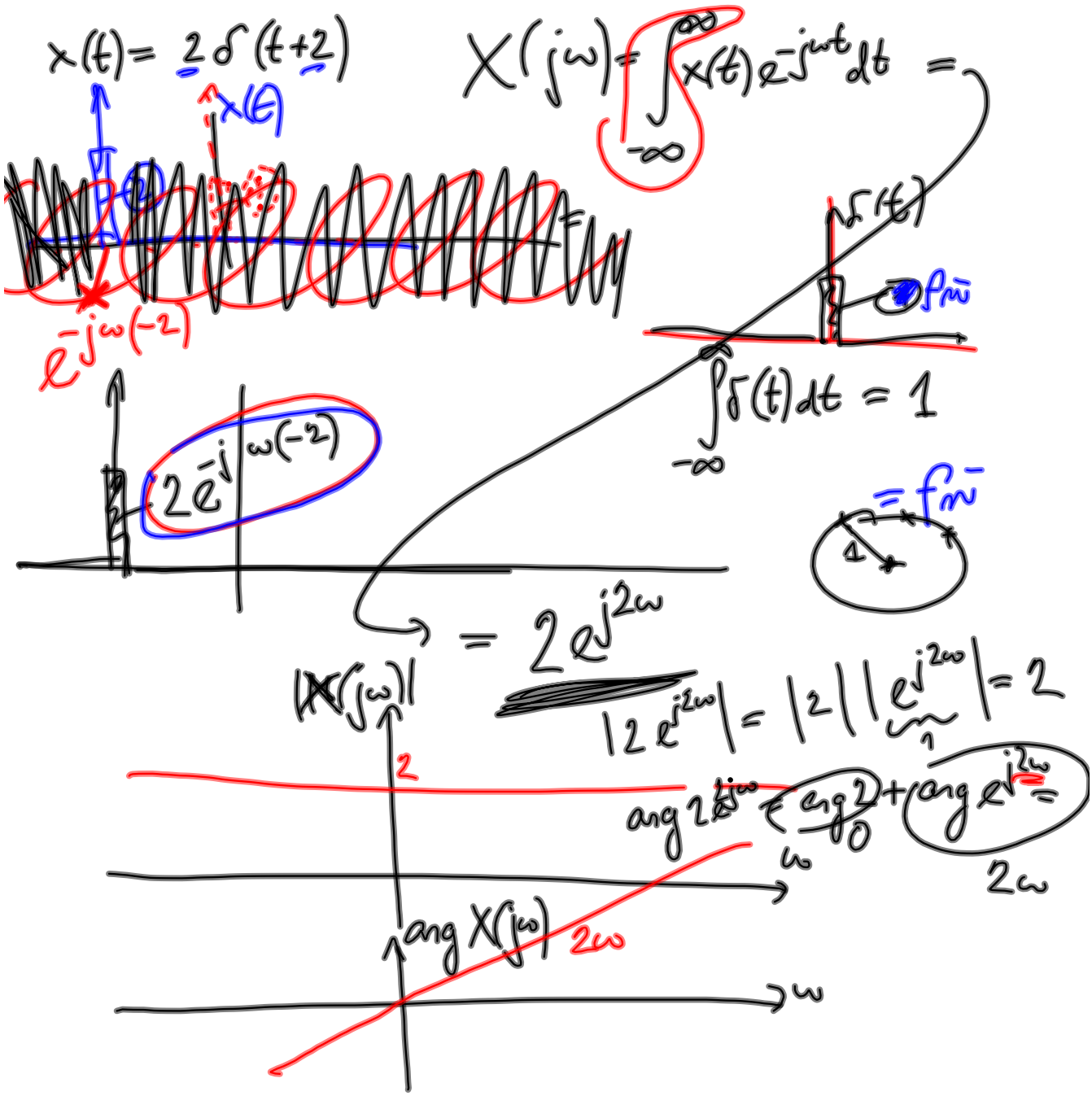
$$= \mathrm{sinc}\left(\frac{\Omega_s}{2}t\right)$$

$\Omega_s = \frac{2\pi}{T}$

$\frac{\Omega_s}{2}t = \pi$

$t = \frac{2\pi}{\Omega_s}$




x(t) = 2δ(t+2)
X(jω) = ∫ x(t) e^{-jωt} dt
e^{-jω(-2)}
2e^{jω(-2)}
δ(t)
∫ δ(t) dt = 1
= 2e^{j2ω}
|X(jω)|
2
arg X(jω)
2ω
ω

$$R[k] = \frac{1}{N-|k|} \sum_{n=-\infty}^{\infty} x[n]\,x[n+k]$$

$5-|2|=3$

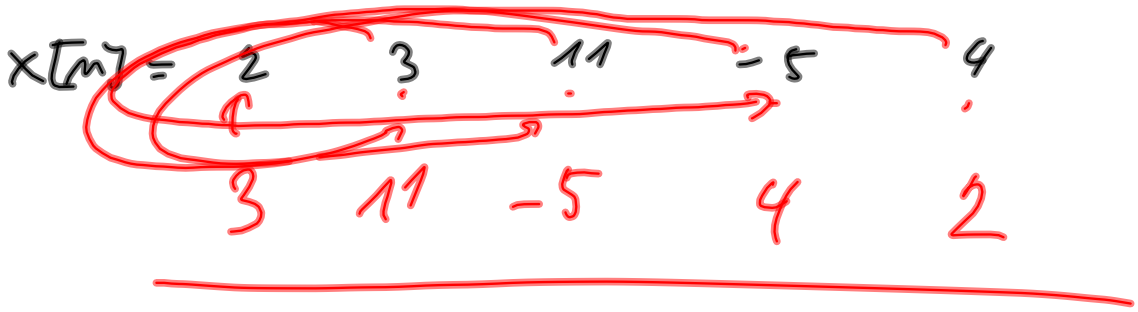
$x[n] = \underset{\uparrow}{3}\ 5\ 2\ -1\ 1$

$x[k,l] = 100 \qquad x_q[k,l] = 110$

$$10 \log_{10} \frac{\text{energie obrazu}}{\text{energie šumu}} = 10 \log_{10} \frac{\sum_k \sum_l |x[k,l]|^2}{\sum_k \sum_l |x_q[k,l] - x[k,l]|^2}$$

$$10 \log_{10} \frac{65536 \cdot 100^2}{65536 \cdot 10^2} = 10 \log_{10} \frac{10000}{100} =$$

$$= 10 \log_{10} 100 = 10 \cdot 2 = 20\,dB$$


x[n] = 2 3 11 -5 4
3 11 -5 4 2

$$i(t) = C\frac{d(x(t)-y(t))}{dt}$$

$$i(t) = \frac{y(t)}{R}$$

$x(t) \to X(s)$

derin. $\to$ krát s

$$C\frac{d(x(t)-y(t))}{dt} = \frac{y(t)}{R}$$

$$H(s) = \frac{Y(s)}{X(s)}$$

$$RC\left(\frac{dx(t)}{dt} - \frac{dy(t)}{dt}\right) = y(t)$$

$$RC\frac{dx(t)}{dt} = y(t) + RC\frac{dy(t)}{dt}$$

$$RC\,X(s)s = Y(s) + RC\,Y(s)s$$

$$X(s)RCs = Y(s)\left[1 + RCs\right]$$

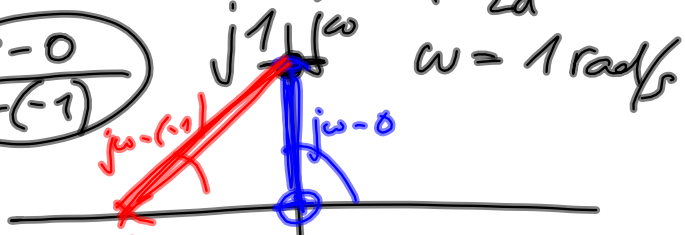
$1\,\Omega$ $1\,F$

$$\frac{Y(s)}{X(s)} = H(s) = \frac{RCs}{1+RCs} =$$

$$= \frac{s}{1+s} = \frac{s-0}{s-(-1)}$$

$$f = \frac{1}{2\pi}\,Hz$$

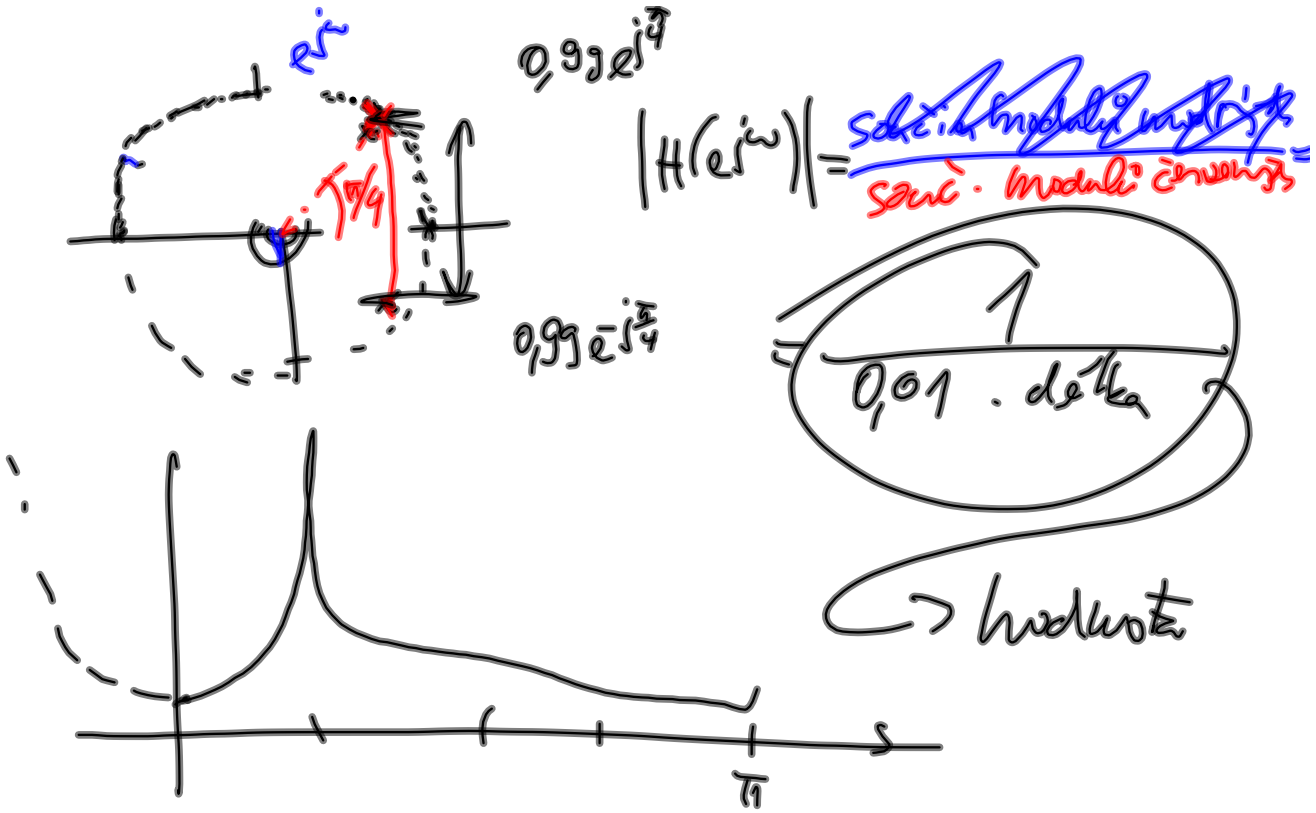
$$\omega = 1\ rad/s$$



$$H(j\omega) = \frac{j\omega - 0}{j\omega - (-1)}$$

$$|H(j1)| = \frac{1}{\sqrt{2}} = 0{,}707$$

$$\arg H(j1) = \frac{\pi}{2} - \frac{\pi}{4} = \frac{\pi}{4}$$


$e^{j\omega}$
$0{,}99e^{j\frac{\pi}{4}}$
$\pi/4$
$0{,}99e^{-j\frac{\pi}{4}}$
$|H(e^{j\omega})| =$
součin modulů činitelů
1
0,01 . délka
π