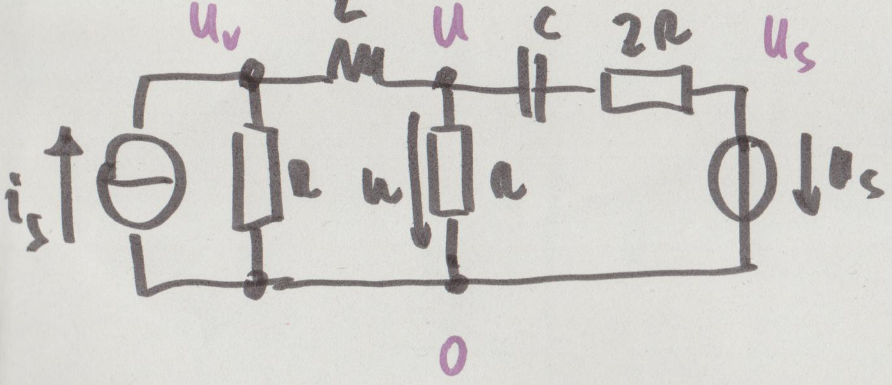
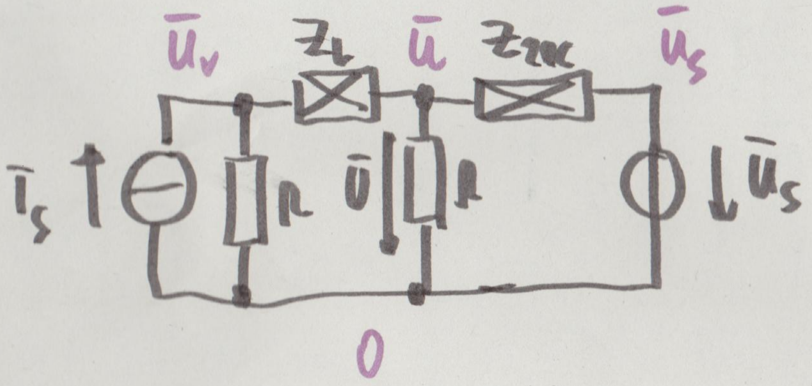
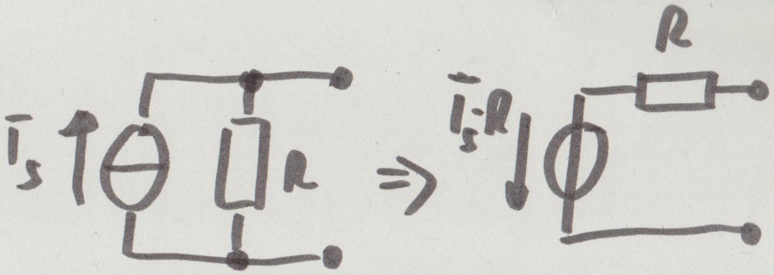
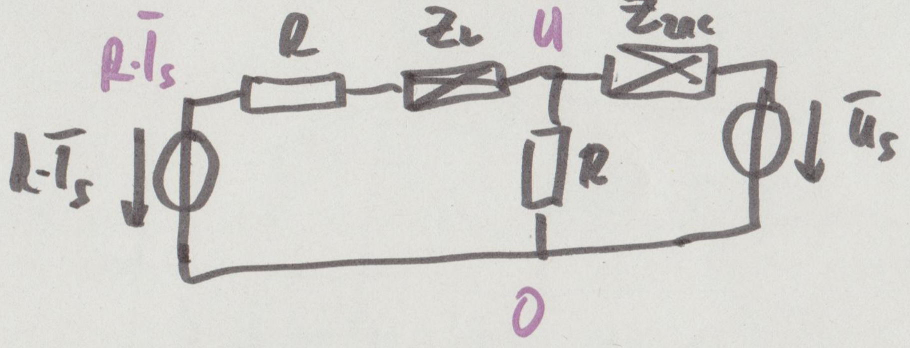




$$\cancel{\bar{U} = (j\omega)^2 CLR\,U_s + j\omega(R^2 C U_s +}$$

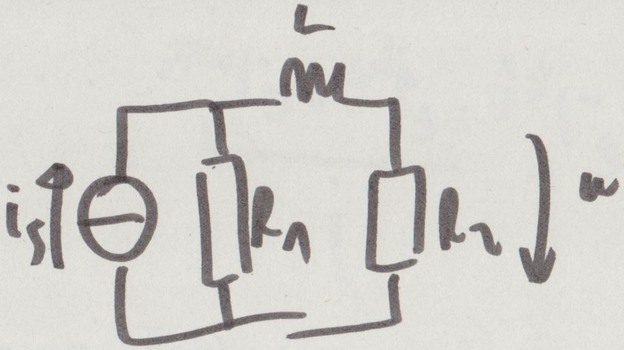
"Trükk":



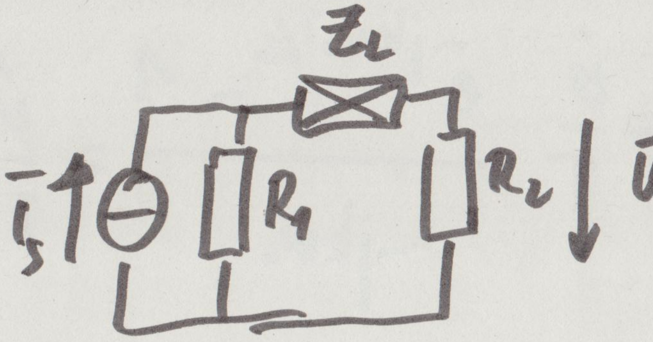


$$\frac{\bar{U} - \bar{I}_s \cdot R}{R + Z_L} + \frac{\bar{U}}{R} + \frac{\bar{U} - \bar{U}_s}{2R + Z_C} = 0$$

$$\bar{U} = \frac{\bar{I}_s \cdot \frac{R}{R + Z_L} + \frac{\bar{U}_s}{2R + Z_C}}{\frac{1}{R} + \frac{1}{R + Z_L} + \frac{1}{2R + Z_C}}$$



$\Rightarrow$



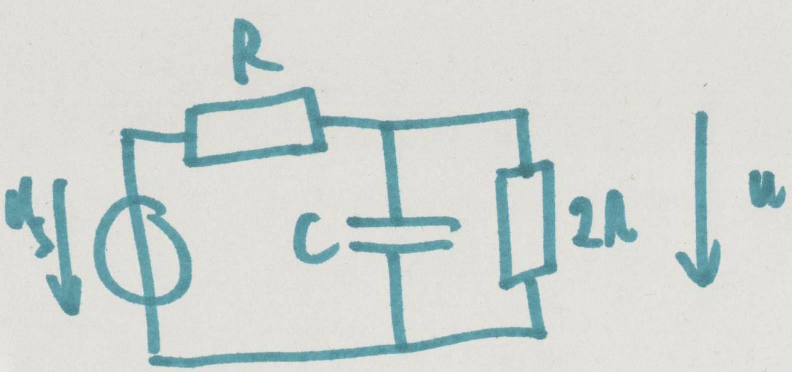
$$\bar{I}_s \to \bar{I}_s(j\omega)$$

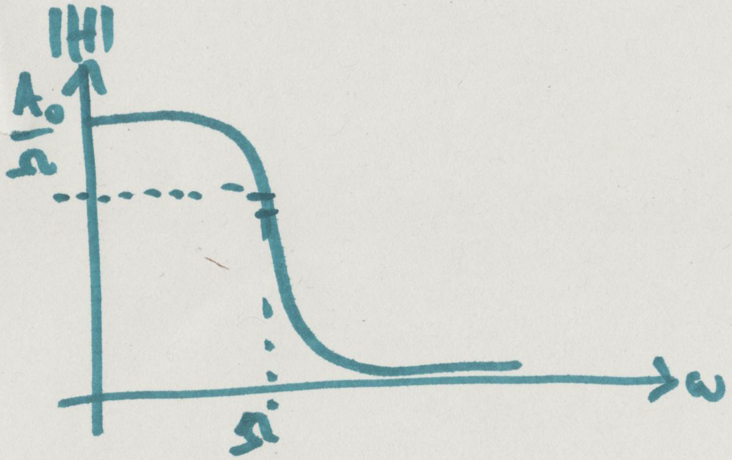
$$\bar{U} = \frac{R_2}{R_2+Z_L}\cdot \bar{I}_s \cdot R_1 \times (R_2+Z_L) = \bar{I}_s \cdot \frac{R_1\cdot\cancel{(R_2+Z_L)}}{R_1+R_2+Z_L}\cdot\frac{R_2}{\cancel{R_2+Z_L}}$$

$$\bar{H} = \frac{\bar{U}}{\bar{I}_s} = \frac{R_1 R_2}{R_1+R_2+Z_L} = \frac{R_1 R_2}{R_1+R_2+j\omega L} = \frac{R_1 R_2}{L}\cdot\frac{1}{j\omega + \underbrace{\frac{R_1+R_2}{R_1 R_2 L}}_{\frac{R_1\times R_2}{L}}}$$

$$\bar{H}(j\omega) = A_0\cdot\frac{1}{j\omega+\Omega}$$

$$[A_0] = \frac{[R]/[L]}{1}\cdot[R] = [\omega]\cdot[R]$$





$$U(j\omega) = \frac{2R \times Z_C}{R + 2R \times Z_C} \cdot U_s(j\omega) =$$

$$= \frac{\frac{2R\cdot Z_C}{2R+Z_C}}{R + \frac{2R\cdot Z_C}{2R+Z_C}} U_s = \frac{2R\cdot Z_C}{2R\cdot Z_C + 2R^2 + R\cdot Z_C} U_s$$

$$\frac{U}{U_s} = \frac{2Z_C}{3Z_C + 2R} = \frac{\frac{2}{j\omega C}}{\frac{3}{j\omega C} + 2R} = \frac{2}{3 + 2j\omega CR} =$$

$$= \frac{2}{2CR} \cdot \frac{1}{j\omega + \frac{3}{2CR}} = \underbrace{\frac{1}{RC}}_{A_0} \cdot \frac{1}{j\omega + \Omega}$$

$$A_0 = 1/RC$$

$$\Omega = \frac{3}{2RC}$$

polinom reprezentáció

$5x^4 - 3x^3 + 9x - 10 \longrightarrow$ együtthatók

$$\begin{array}{c} s = [\,5\ \ -3\ \ 0\ \ 9\ \ -10\,] \\ \uparrow\ \ \ \uparrow\ \ \ \uparrow\ \ \uparrow\ \ \ \uparrow \\ x^4\ \ x^3\ \ x^2\ \ x\ \ 1 \end{array}$$

polyval(s, 3)

$x=3$ helyettesítés $\rightarrow 341$

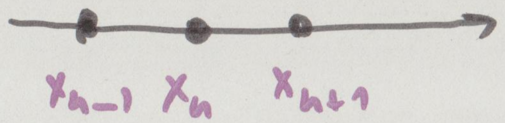
polyval(s,[1 2 3])

$x=1$
$x=2$
$x=3$

↳ [1 64 341]

```
x = 0:0.1:10;
y=polyval(s,x); plot(x,y,'r-o');
```

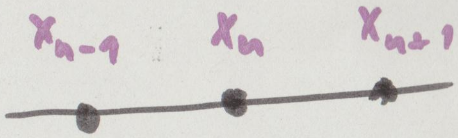
Lineáris távolságú pontok



távolság állandó! $\boxed{x_n - x_{n-1} = x_{n+1} - x_n}$

$$\Rightarrow x_n = \frac{x_{n+1} + x_{n-1}}{2}$$

logaritmikusan egyenközű pontok

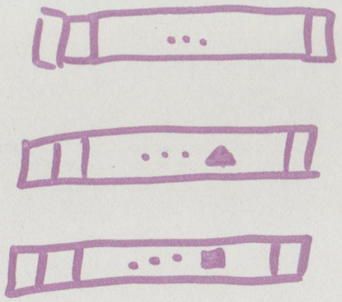


arány állandó!

$$\boxed{\frac{x_n}{x_{n-1}} = \frac{x_{n+1}}{x_n}} \rightarrow x_n = \sqrt{x_{n-1} \cdot x_{n+1}}$$

Polinom kifejezés ábrázolás

```
om = 0:0.1:100;
```



1×1001

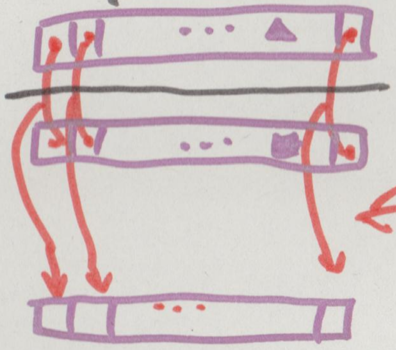
1×1001

1×1001

```
num = [3 2 1]      → polyval(num, j*om)
den = [1 -2 3 4]   → polyval(den, j*om)
```

elementenkénti műveletvégzés (osztás)

$$\frac{3x^2+2x+1}{x^3-2x^2+3x+4} \rightarrow$$



→ polyval(num, j*om) ./ polyval(den, j*om)

olyan mintha for-ral végig mennénk

```
n1 = polyval(num, j*om);
d1 = polyval(den, j*om);
p = zeros(size(n1));
for id = 1:length(n1)
    p(id) = n1(id) / d1(id);
end
```

$u_s(t) = [3 + 2\cdot\cos(1t) + 4\cdot\cos(2t - 0{,}5)]\,\mathrm{V}$

$R = 2\ \mathrm{k\Omega}$;

$C = 0{,}4\ \mathrm{\mu F}$

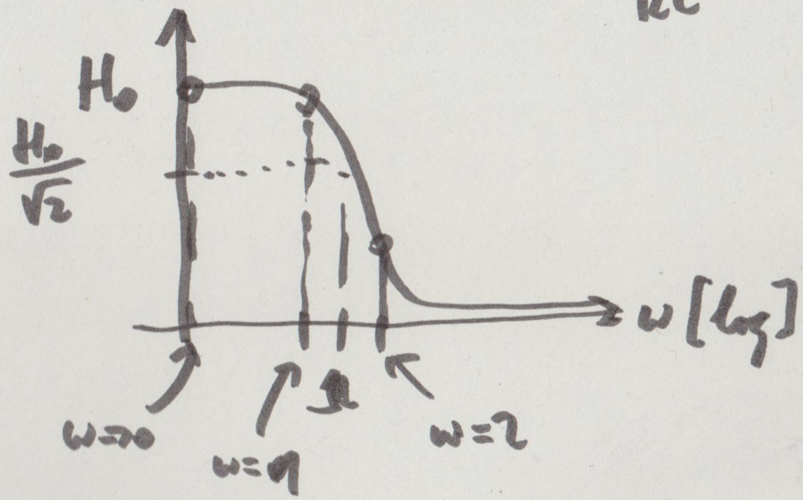
$u(t) = ?$

$H(j\omega) = A_0 \cdot \dfrac{1}{j\omega + \Omega}$

$\dfrac{1}{RC} = 1{,}25\ \dfrac{\mathrm{Mrad}}{\mathrm{s}}$

$A_0 = \dfrac{1}{RC} = 1{,}25$

$\Omega = \dfrac{3}{2RC} = 1{,}875$

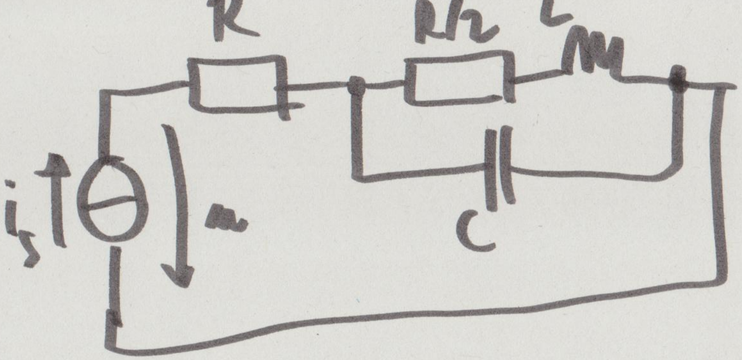


ω	0	1	2
$\bar{U}_s$	3	2	$4e^{-j0{,}5}$
$\bar{H}$	$\frac{1{,}25}{1{,}875} = \frac{2}{3}$	$0{,}5883\ \angle -0{,}49$	$0{,}4559\ \angle -0{,}817$
$\bar{Y}$	2	$1{,}1765\ \angle -0{,}49$	$1{,}8238\ \angle -1{,}317$

Teljes megoldás:

$[2 + 1{,}1765\cdot\cos(1t - 0{,}49) +$

$+ 1{,}8238\cdot\cos(2t - 1{,}317)]\,\mathrm{V}$



$$u(j\omega) = \underline{I}(j\omega)\left\{R + \frac{1}{j\omega C} * \left(\frac{R}{2} + j\omega L\right)\right\} = \underline{I}(j\omega)\left\{R + \frac{\frac{1}{j\omega C}\cdot\left(\frac{R}{2} + j\omega L\right)}{\frac{1}{j\omega C} + \frac{R}{2} + j\omega L}\right\}$$

$$= I(j\omega)\cdot R + \frac{R + j\omega 2L}{2 + j\omega CR + (j\omega)^2 2LC} = I(j\omega)\cdot\left\{\frac{2R + j\omega\cdot CR^2 + (j\omega)^2 2CLR + R + j\omega 2L}{2 + j\omega CR + (j\omega)^2 2LC}\right\}$$

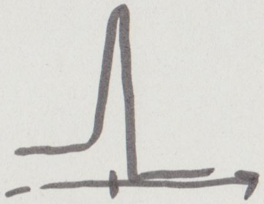
$$= I(j\omega)\cdot\frac{(j\omega)^2 2CLR + j\omega(CR^2 + 2L) + 3R}{(j\omega)^2 2CL + j\omega CR + 2} = I(j\omega)\underbrace{\frac{2CLR}{2CL}}_{R}\cdot\frac{(j\omega)^2 + j\omega\left(\frac{R}{2L} + \frac{1}{RC}\right) + \frac{3}{2LC}}{(j\omega)^2 + j\omega\frac{R}{2L} + \frac{1}{LC}}$$

$L = 1\,\mu H$ μH, pF, ns, Grad/s, kΩ

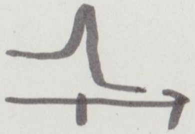
$C = 0{,}9\,pF$

$R = 0{,}1\,k\Omega$

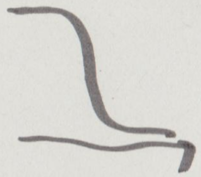
$$H(j\omega) = \frac{0{,}1\,(j\omega)^2 + 1{,}1161\,j\omega + 0{,}1667}{(j\omega)^2 + 0{,}05\,j\omega + 1{,}1111}$$



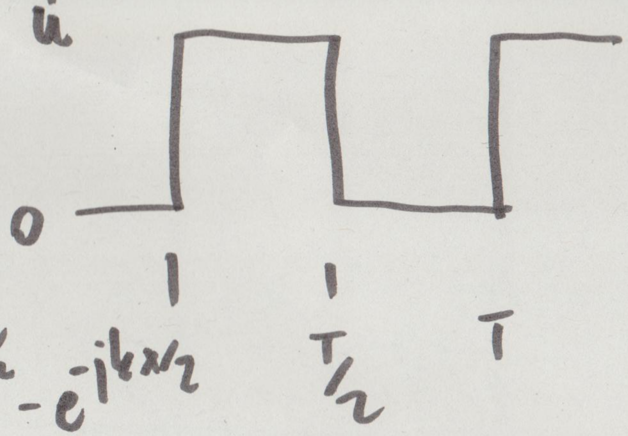
$R = 1\,k\Omega$ $$\frac{(j\omega)^2 + 1{,}6111\,j\omega + 1{,}6667}{(j\omega)^2 + 0{,}5\,j\omega + 1{,}1111}$$



$R = 10\,k\Omega$ $$\frac{10(j\omega)^2 + 51{,}111\,j\omega + 16{,}667}{(j\omega)^2 + 5\,j\omega + 1{,}1111}$$

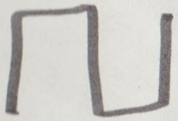


$$\bar{U}_k = \frac{1}{T}\int_0^T u(t)\, e^{-jk\omega_0 t}\, dt =$$



$$= \frac{1}{T}\left[\frac{e^{-jk\omega_0 T/2} - 1}{-jk\omega_0}\right]\hat{u} = \frac{\hat{u}}{T}\cdot\frac{T}{2\pi}\cdot\frac{1}{k}\cdot\underbrace{\frac{e^{jkx/2} - e^{-jkx/2}}{j}}_{2\cdot\sin\left(\frac{kx}{2}\right)}\cdot e^{-jkx/2}$$

$$x = \frac{\omega_0 T}{2} = \frac{2\pi}{T}\cdot\frac{T}{2} = \pi$$

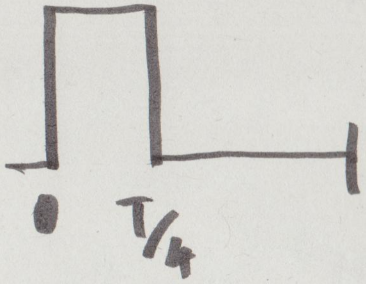


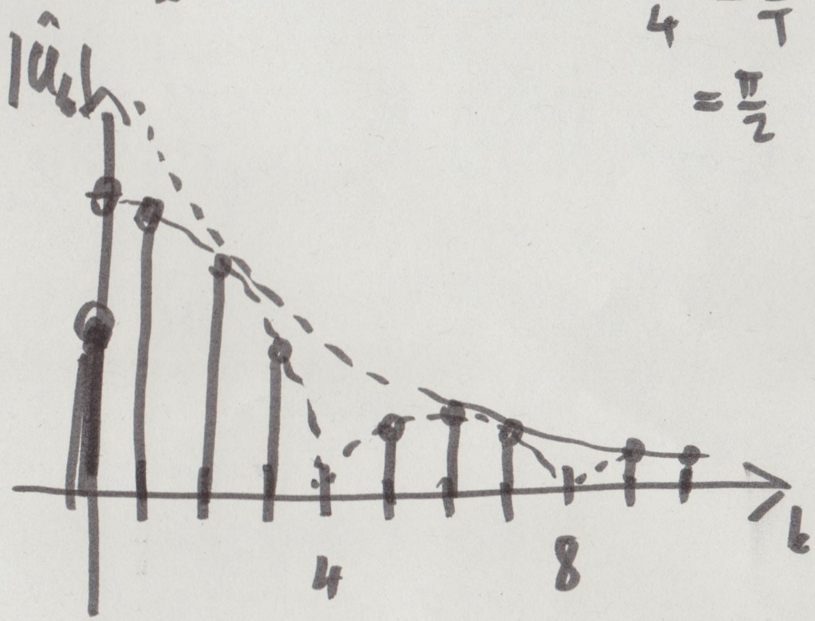
$\frac{\hat{u}_k}{\hat{u}}$	0,5	0,6366	0,2122	0,1273	0,0905	0,0707
φ_k	–	$-\pi/2$	$-\pi/2$	$-\pi/2$	$-\pi/2$	$-\pi/2$
ω/ω_0	0	1	3	5	7	9

$$\hat{U}_k = \frac{\hat{U}}{T}\,\frac{e^{-jk\omega_0 T/4}-1}{-jk\omega_0} = \frac{\hat{U}}{T}\cdot\frac{T}{2\pi}\cdot\underbrace{\frac{1}{\cancel{k}}}_{\frac{1}{k}}\cdot e^{-jk\frac{x}{2}}\,\frac{e^{jk\frac{x}{2}}-e^{-jkx/2}}{j} =$$

$$= \frac{\hat{u}}{\pi\cdot k}\cdot\sin\left(k\pi/4\right)e^{-jk\pi/4}$$

$$x = \frac{\omega_0 T}{4} = \frac{2\pi}{T}\cdot\frac{T}{4} = \frac{\pi}{2}$$





$\hat{U}_k$	0,25	0,4502	0,3183	0,1501	0	0,09	0,1061	0,0643	0
φ_k	–	$-\pi/4$	$-\frac{\pi}{2}$	$-\frac{3\pi}{4}$	–	$-\pi/4$	$-\frac{\pi}{2}$	$-\frac{3\pi}{4}$	–
k	0	1	2	3	4	5	6	7	8