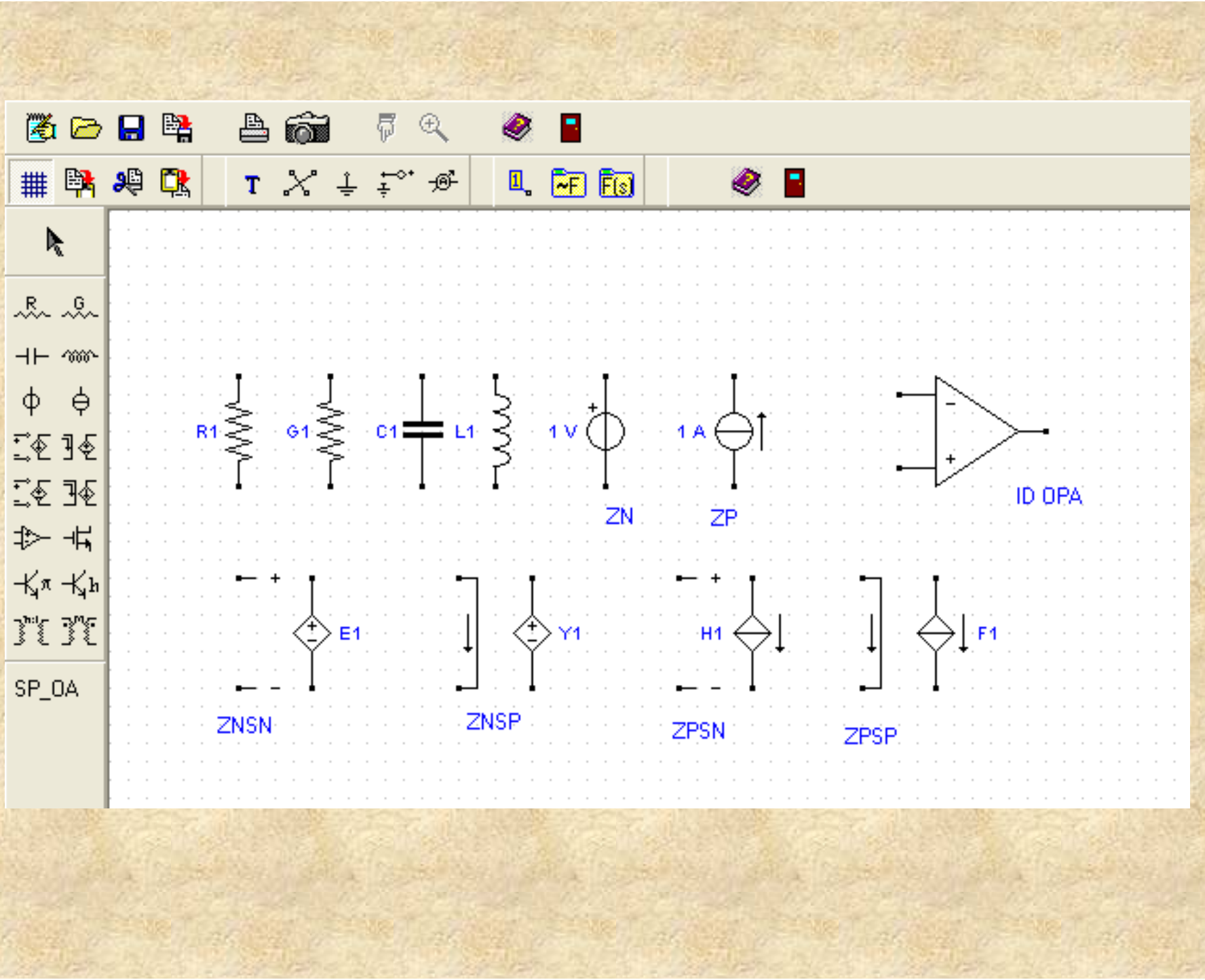
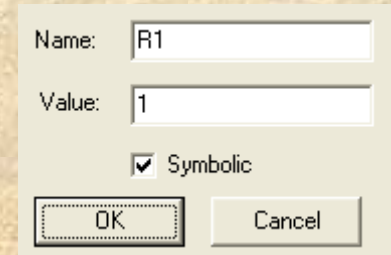
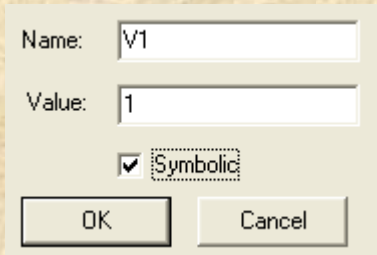
Zajęcia 4

Program SapWin

Rozwiązywanie liniowych obwodów elektrycznych


R1
G1
C1
L1
1 V
1 A
ID OPA
ZN
ZP
E1
Y1
H1
F1
ZNSN
ZNSP
ZPSN
ZPSP
SP_OA

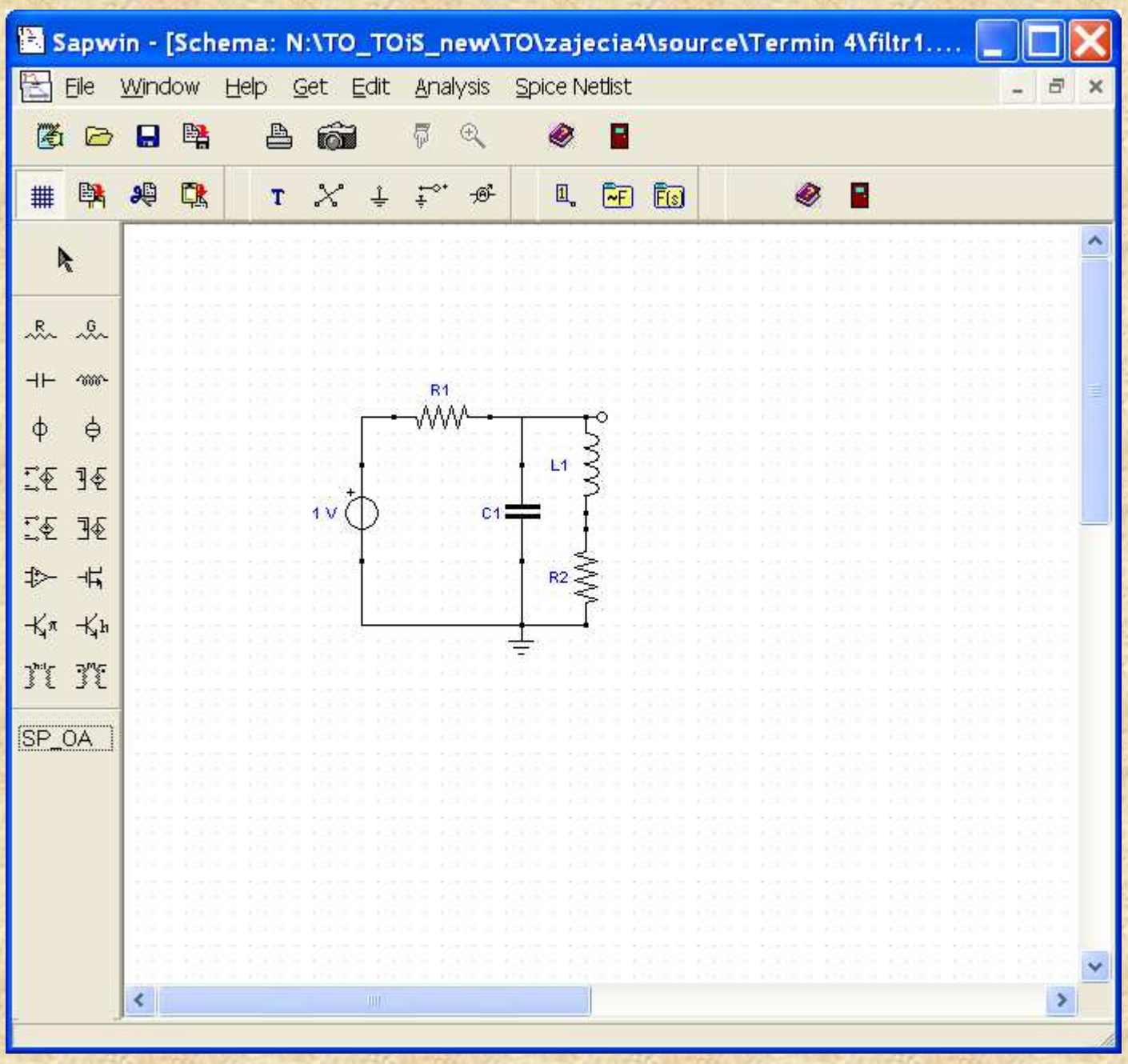


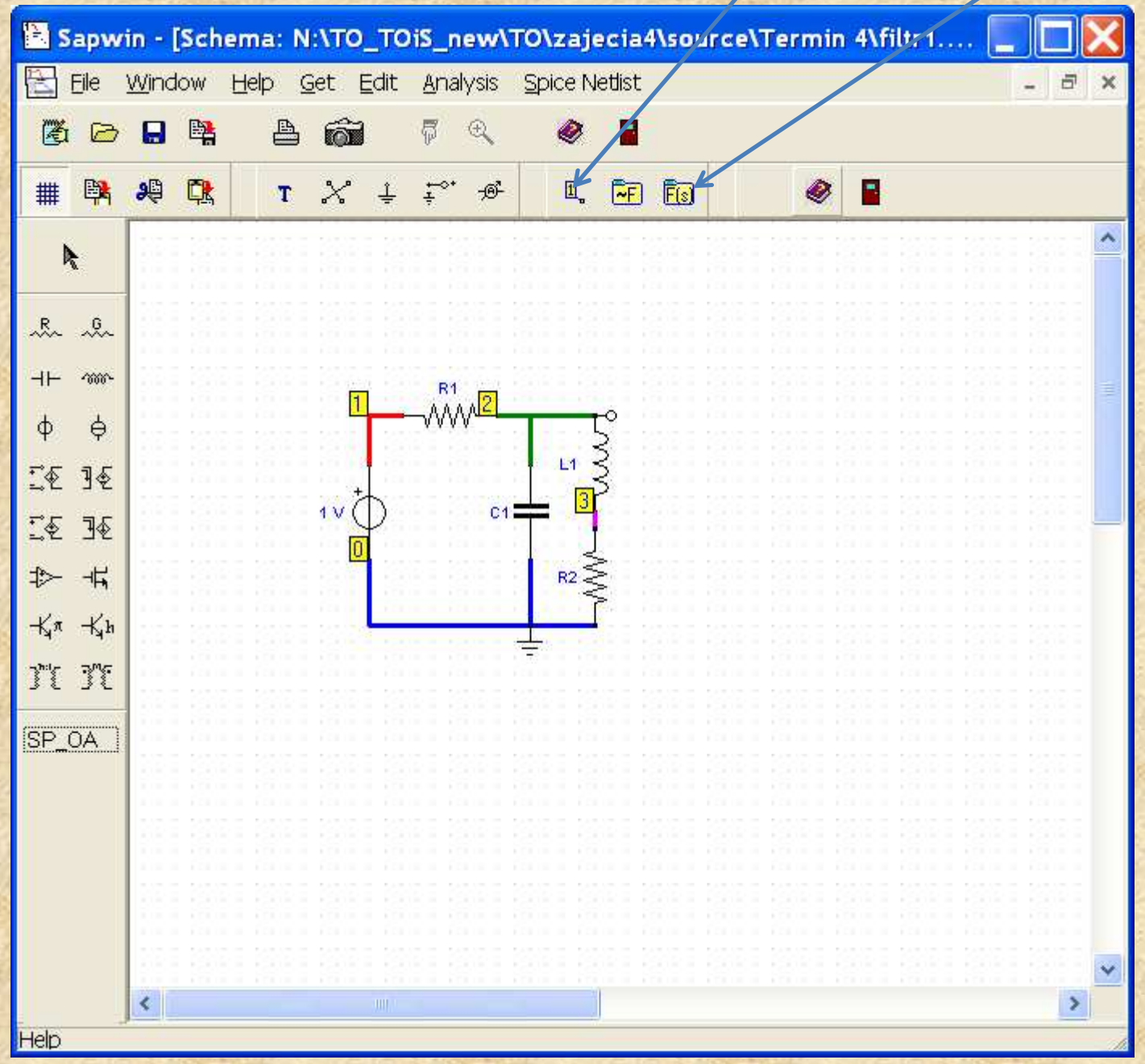


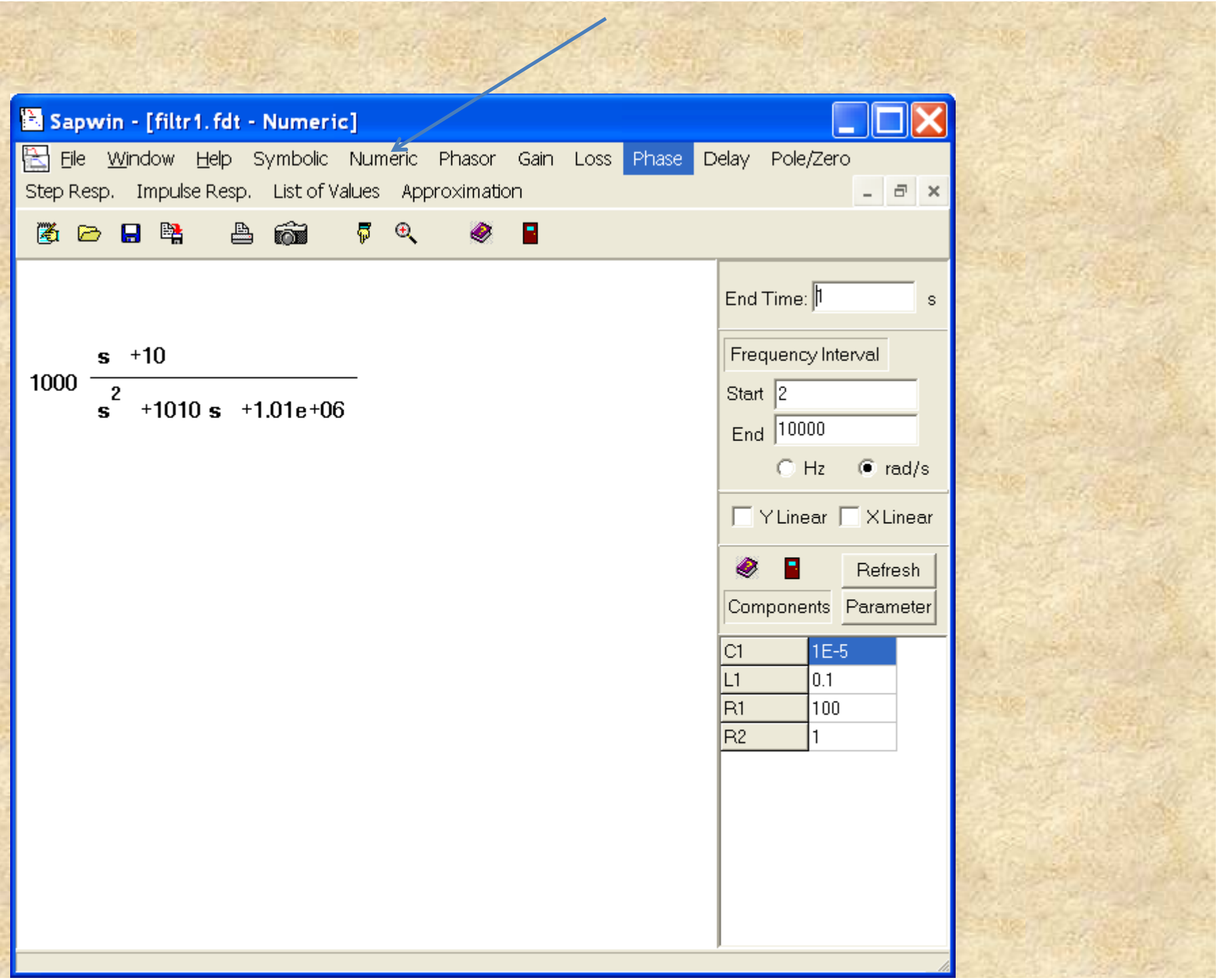
Uwaga!

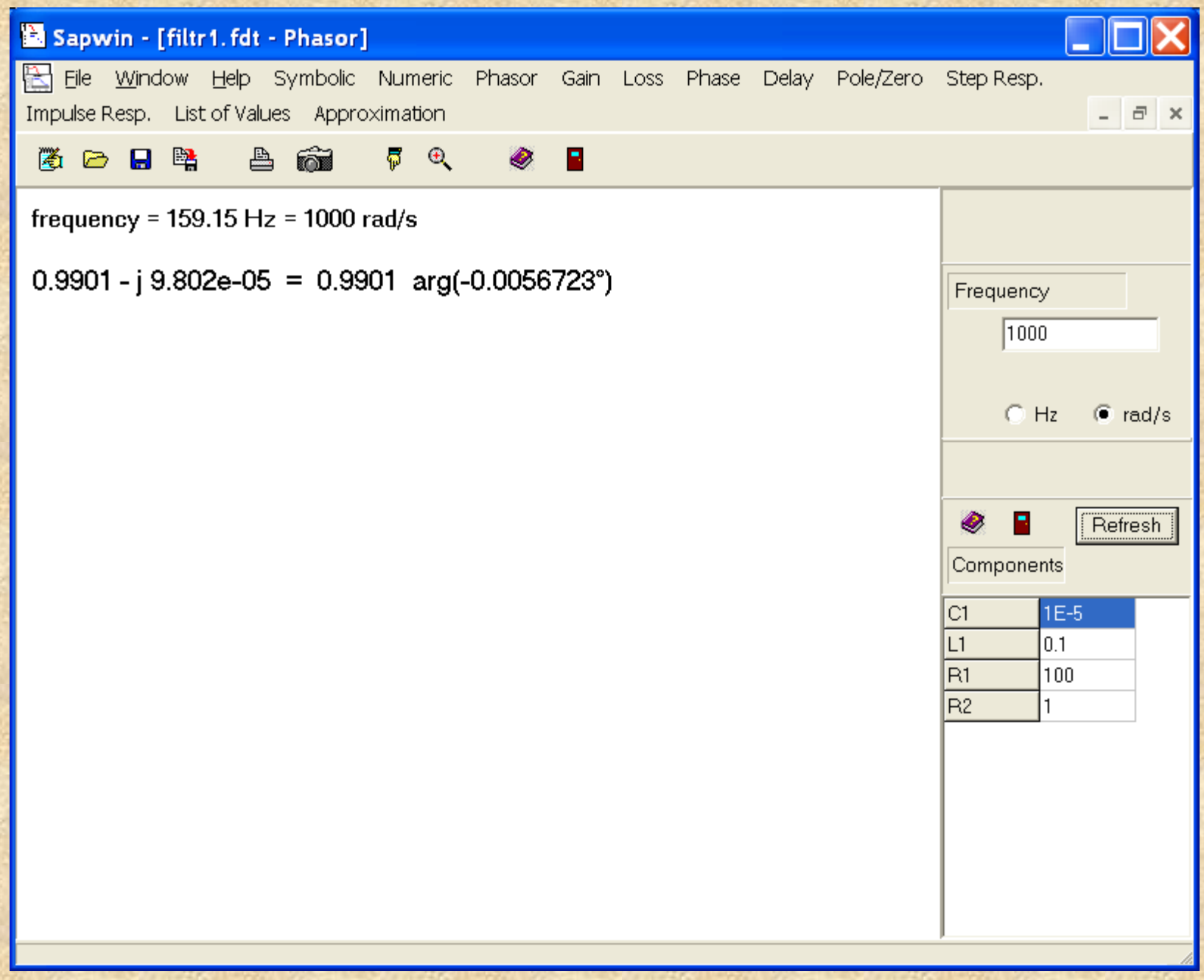
Linie, które nie mają się łączyć nie mogą krzyżować się pod kątem prostym!

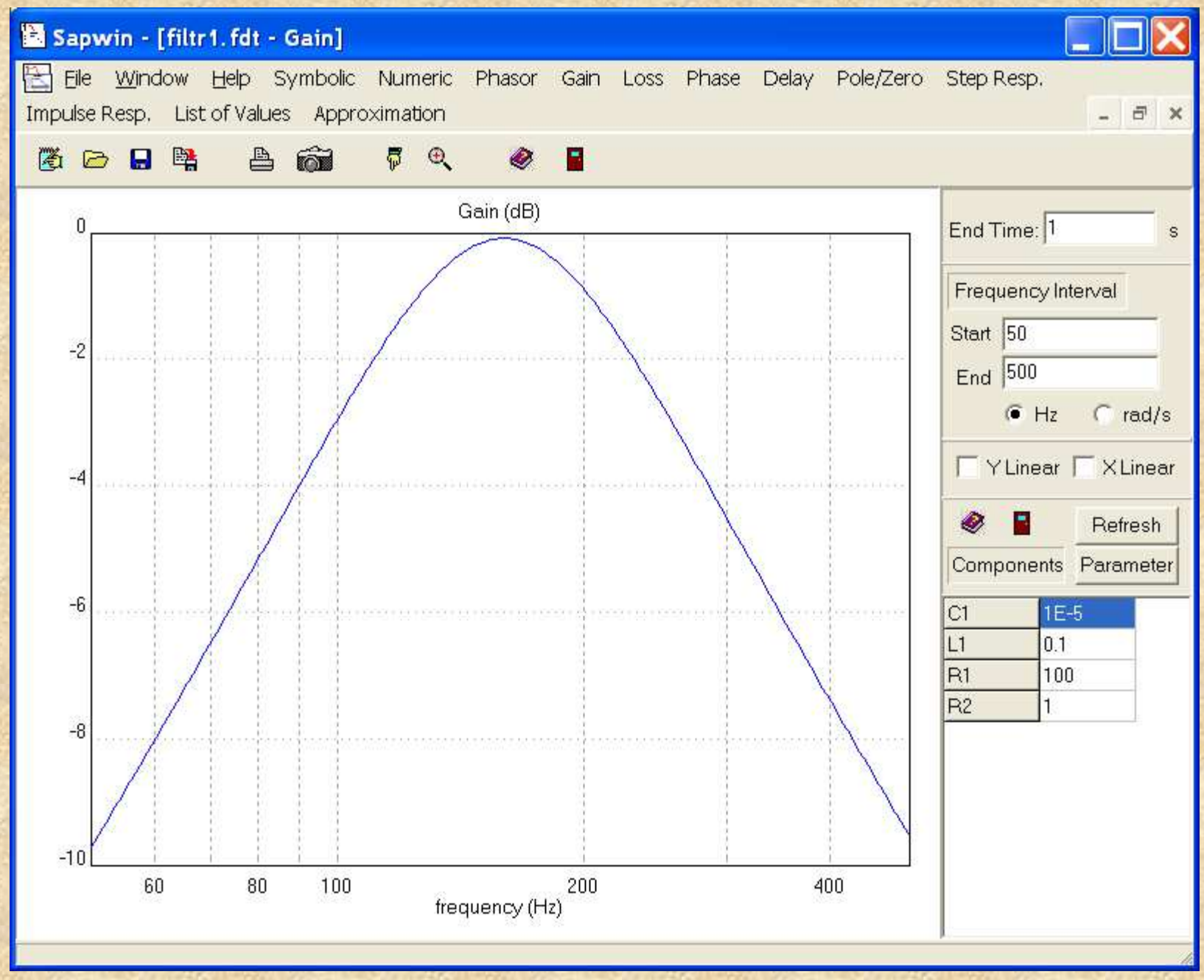
Na schemacie musi być zaznaczone jedno (i tylko jedno) napięcie lub prąd wyjściowe

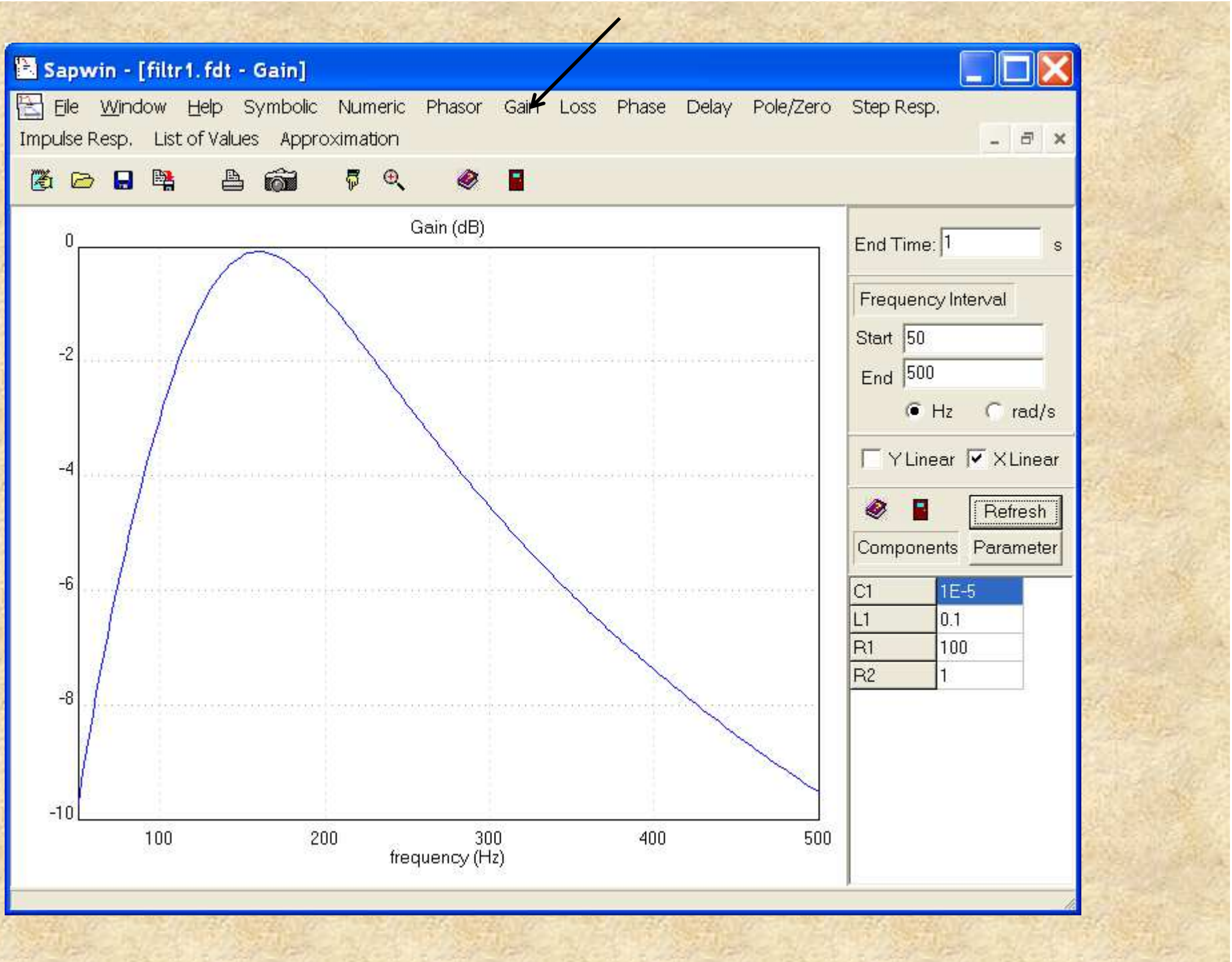

Sapwin - [Schema: N:\TO_TOiS_new\TO\zajecia4\source\Termin 4\filtr1....
File
Window
Help
Get
Edit
Analysis
Spice Netlist
R1
L1
1 V
C1
R2
SP_OA

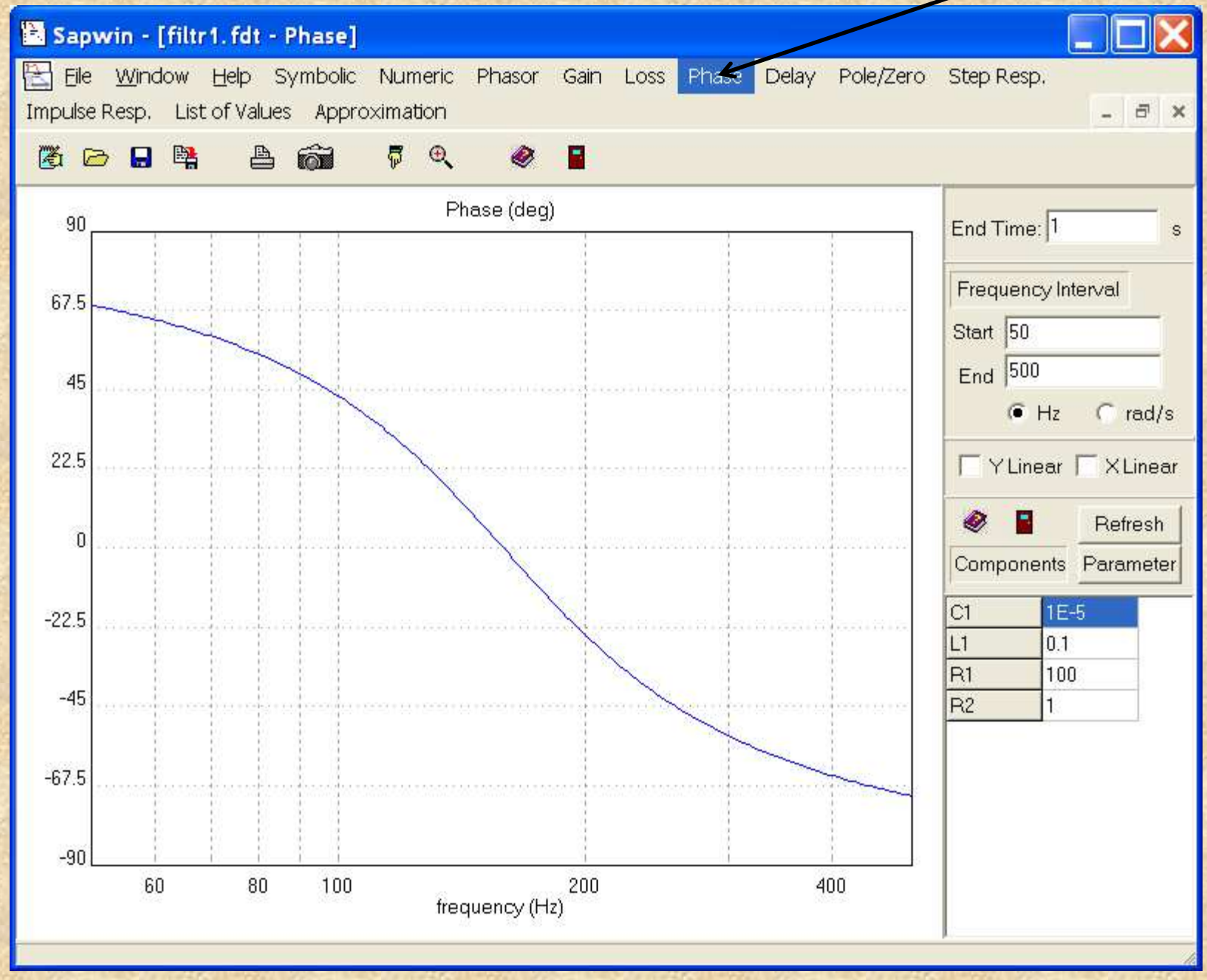

Sapwin - [Schema: N:\TO_TOiS_new\TO\zajecia4\source\Termin 4\filt
File
Window
Help
Get
Edit
Analysis
Spice Netlist
R1
L1
C1
R2
1 V
1
2
3
0
SP_OA
Help

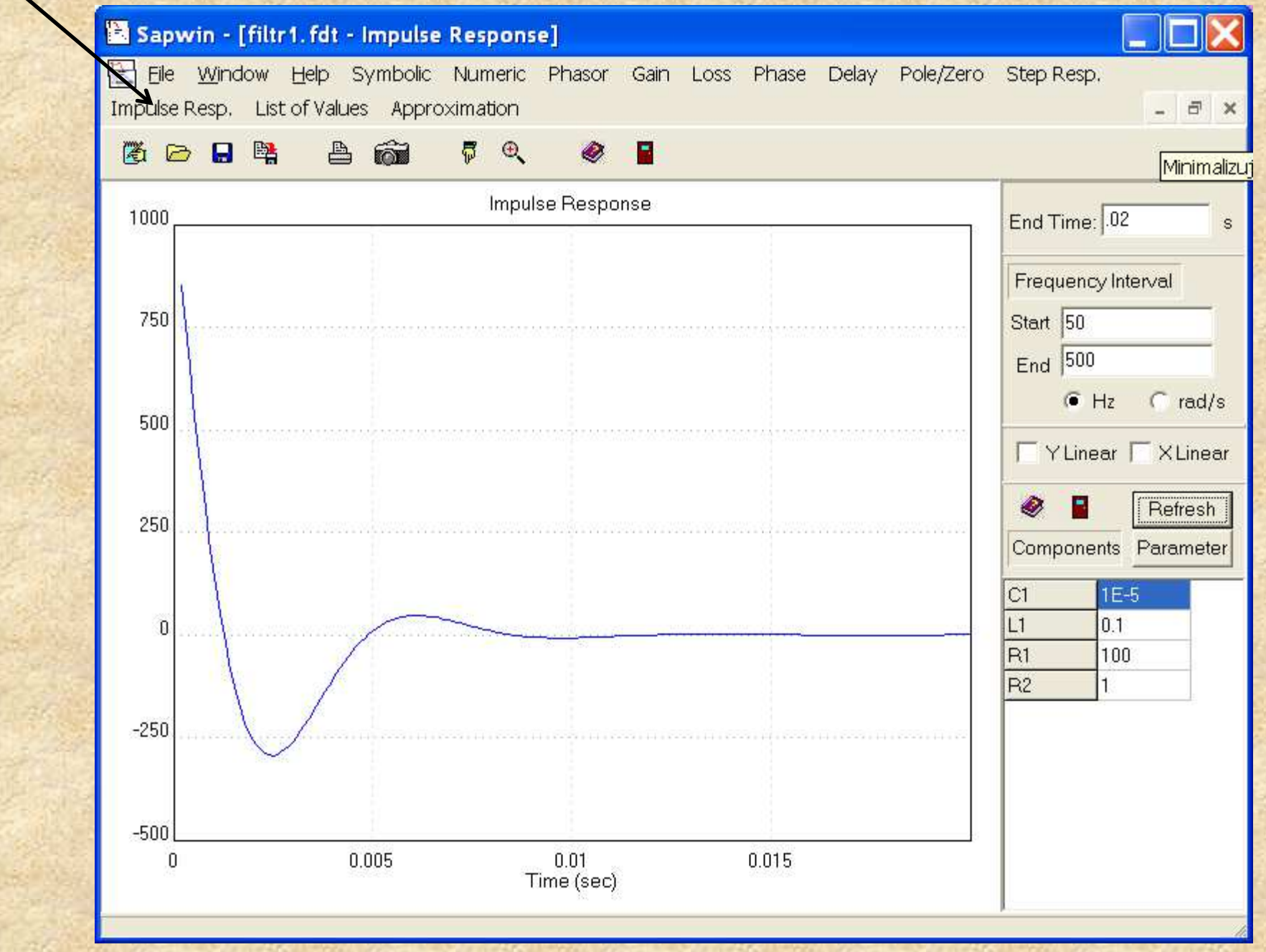

Sapwin - [filtr1.fdt - Numeric]
File Window Help Symbolic Numeric Phasor Gain Loss Phase Delay Pole/Zero
Step Resp. Impulse Resp. List of Values Approximation
1000 (s +10) / (s^2 +1010 s +1.01e+06)
End Time: 1 s
Frequency Interval
Start 2
End 10000
Hz rad/s
Y Linear X Linear
Refresh
Components Parameter
C1 1E-5
L1 0.1
R1 100
R2 1

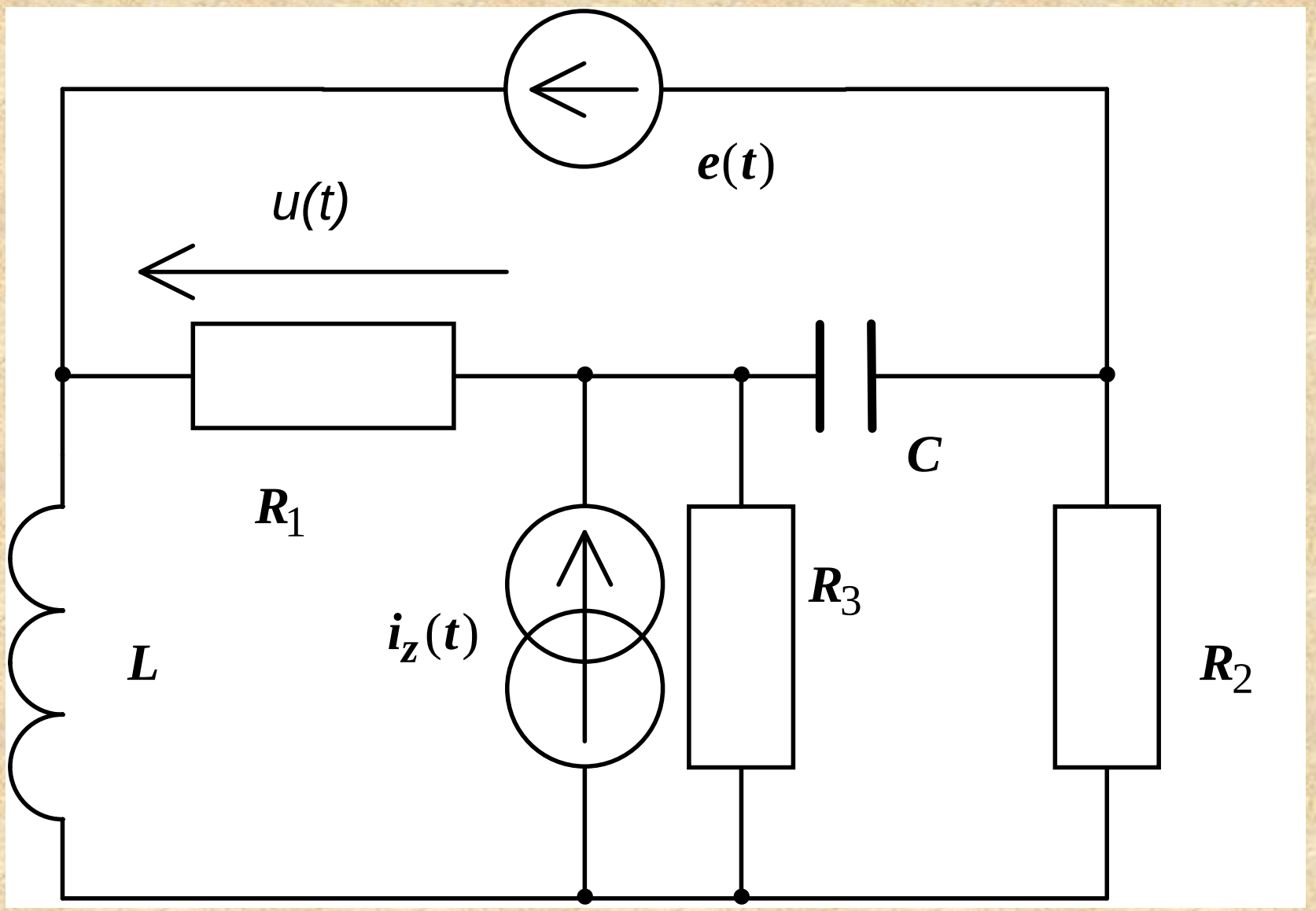

Sapwin - [filtr1.fdt - Phasor]
File Window Help Symbolic Numeric Phasor Gain Loss Phase Delay Pole/Zero Step Resp.
Impulse Resp. List of Values Approximation
frequency = 159.15 Hz = 1000 rad/s
0.9901 - j 9.802e-05 = 0.9901 arg(-0.0056723°)
Frequency
1000
Hz
rad/s
Refresh
Components
C1 1E-5
L1 0.1
R1 100
R2 1


Sapwin - [filtr1.fdt - Gain]
File Window Help Symbolic Numeric Phasor Gain Loss Phase Delay Pole/Zero Step Resp.
Impulse Resp. List of Values Approximation
Gain (dB)
0
-2
-4
-6
-8
-10
60
80
100
200
400
frequency (Hz)
End Time: 1 s
Frequency Interval
Start 50
End 500
Hz rad/s
Y Linear X Linear
Refresh
Components Parameter
C1 1E-5
L1 0.1
R1 100
R2 1

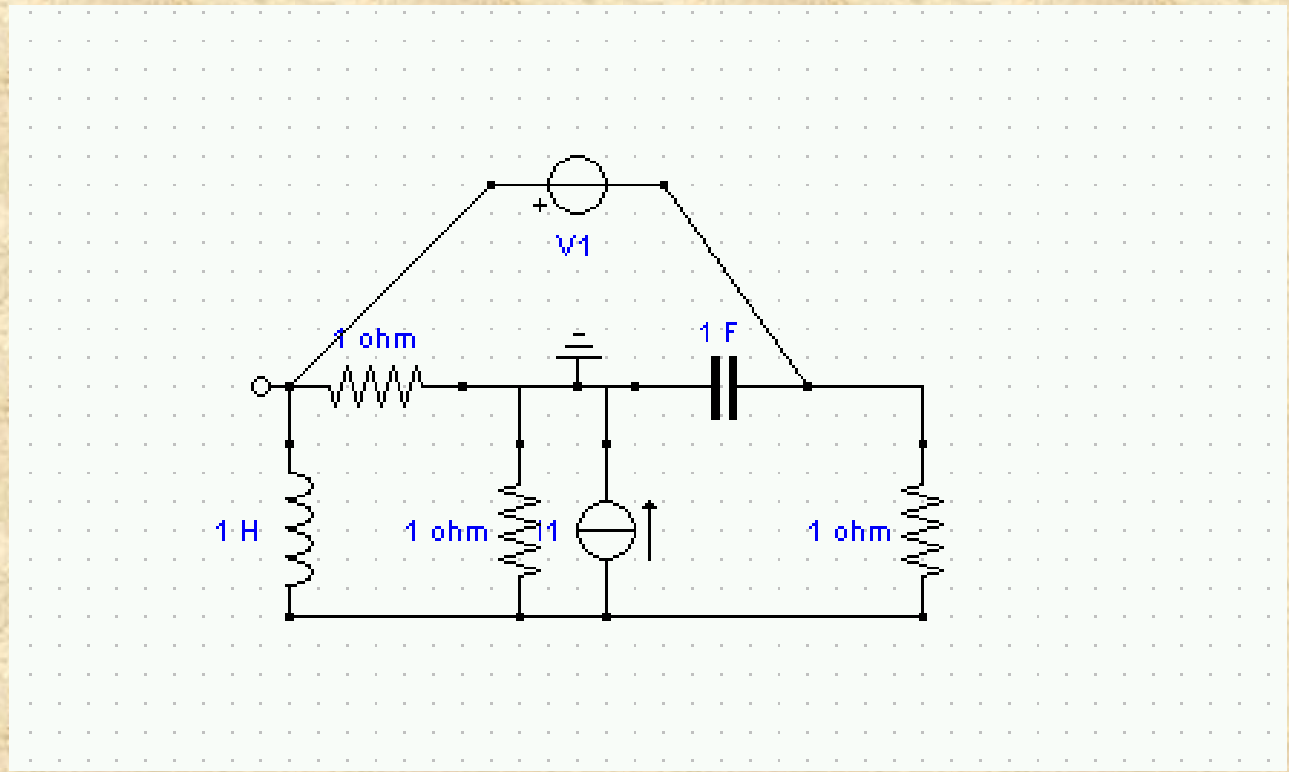

Sapwin - [filtr1.fdt - Gain]
File Window Help Symbolic Numeric Phasor Gain Loss Phase Delay Pole/Zero Step Resp.
Impulse Resp. List of Values Approximation
Gain (dB)
0
-2
-4
-6
-8
-10
100
200
300
400
500
frequency (Hz)
End Time: 1 s
Frequency Interval
Start 50
End 500
Hz rad/s
Y Linear X Linear
Refresh
Components Parameter
C1 1E-5
L1 0.1
R1 100
R2 1


Sapwin - [filtr1.fdt - Phase]
File Window Help Symbolic Numeric Phasor Gain Loss Phase Delay Pole/Zero Step Resp.
Impulse Resp. List of Values Approximation
Phase (deg)
90
67.5
45
22.5
0
-22.5
-45
-67.5
-90
60
80
100
200
400
frequency (Hz)
End Time: 1 s
Frequency Interval
Start 50
End 500
Hz rad/s
Y Linear X Linear
Refresh
Components Parameter
C1 1E-5
L1 0.1
R1 100
R2 1

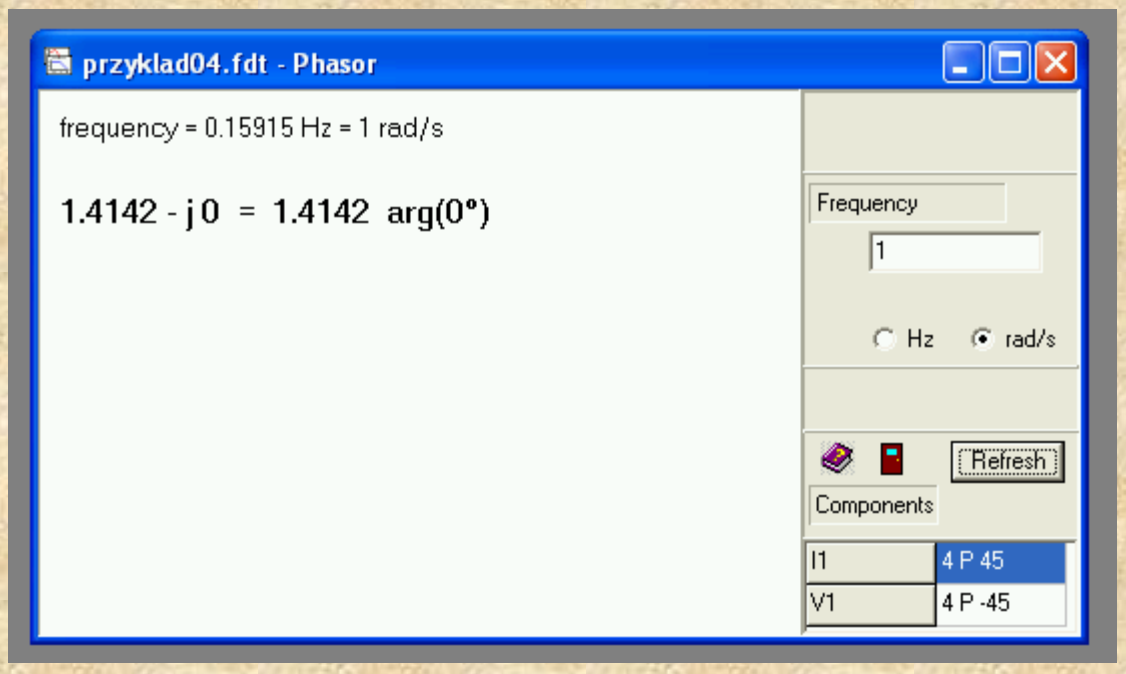

Sapwin - [filtr1.fdt - Impulse Response]
File Window Help Symbolic Numeric Phasor Gain Loss Phase Delay Pole/Zero Step Resp.
Impulse Resp. List of Values Approximation
Minimalizuj
Impulse Response
1000
750
500
250
0
-250
-500
0
0.005
0.01
0.015
Time (sec)
End Time: .02 s
Frequency Interval
Start 50
End 500
Hz rad/s
Y Linear X Linear
Refresh
Components Parameter
C1 1E-5
L1 0.1
R1 100
R2 1



$$e(t) = 4\sin(t - \frac{\pi}{4}), i_z(t) = 4\sin(t + \frac{\pi}{4}), R_1 = 1, R_2 = 1,\ R_3 = 1, C = 1, L = 1.$$


+
V1
1 ohm
1 F
1 H
1 ohm
I1
1 ohm

$$e(t)=4\sin(t-\frac{\pi}{4}), i_z(t)=4\sin(t+\frac{\pi}{4}), R_1=1, R_2=1,\ R_3=1, C=1, L=1.$$

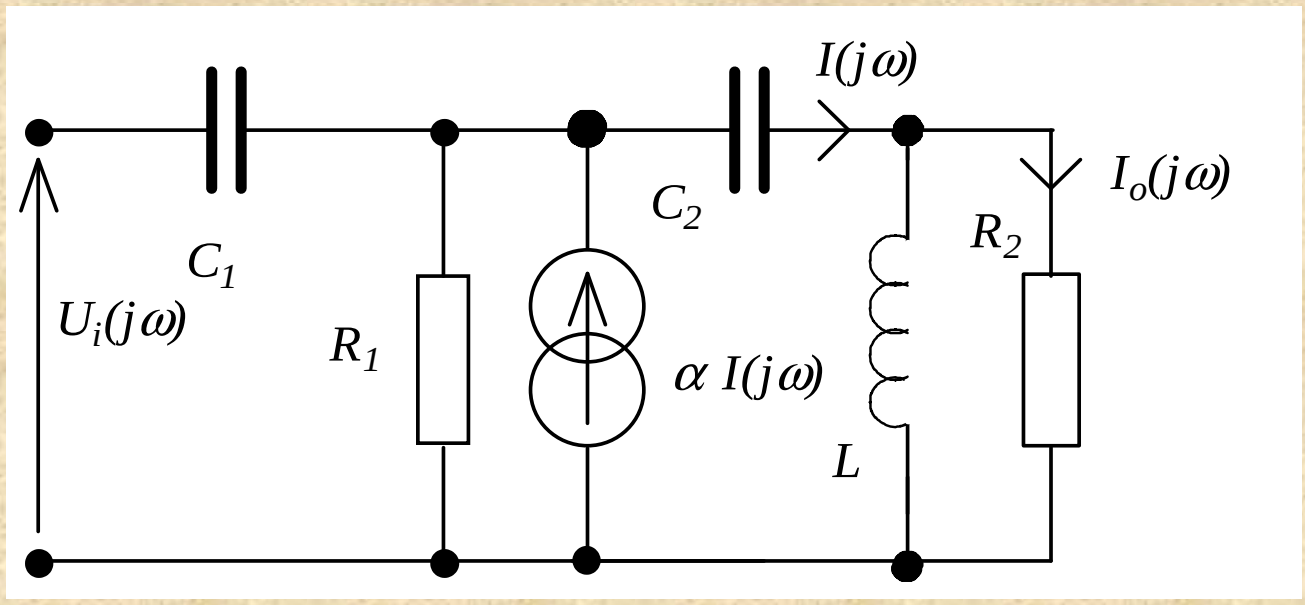


$$u(t)=1.4142\sin(t)=\sqrt{2}\sin(t).$$

Wyznaczyć charakterystykę widmową

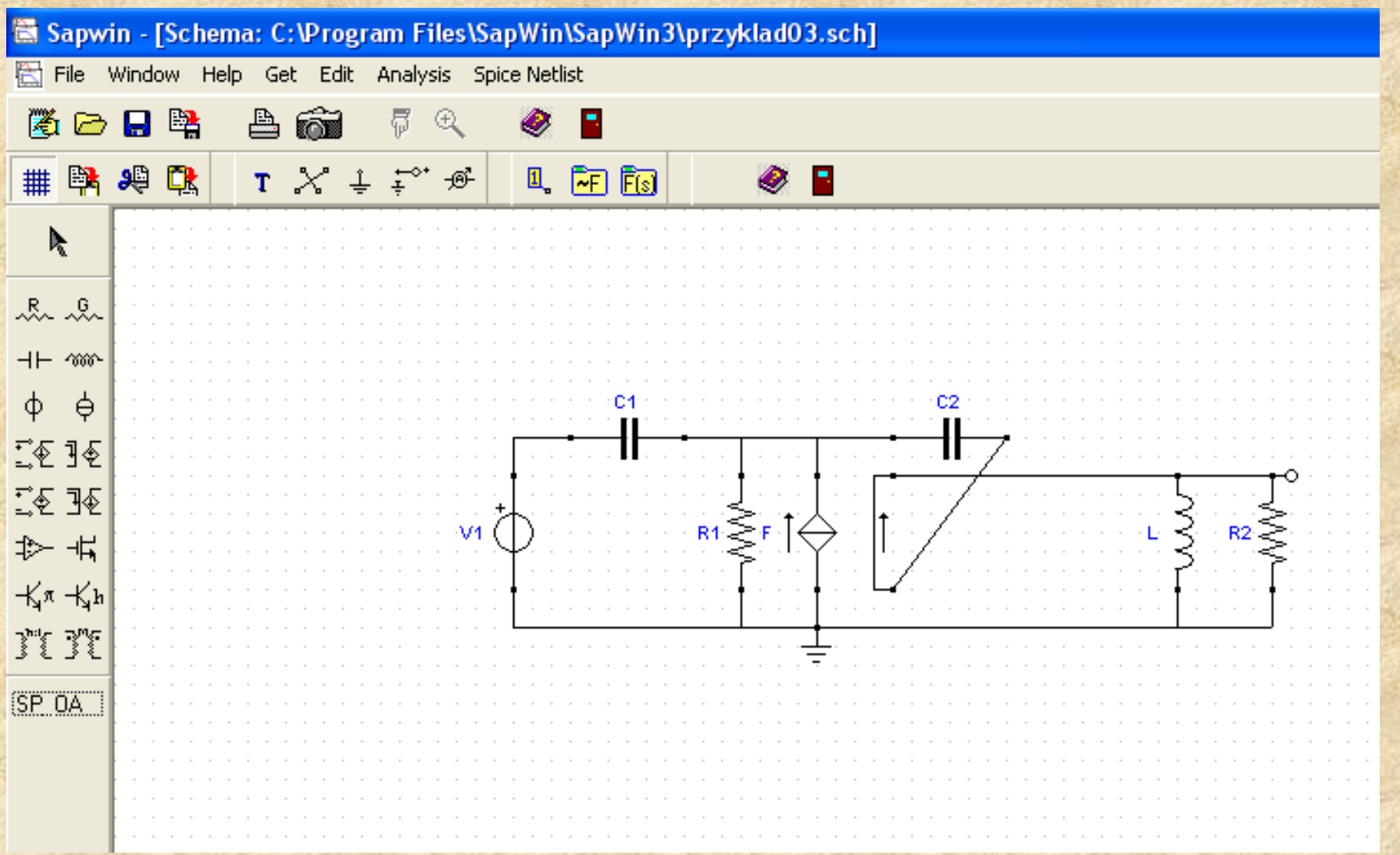
$$H(j\omega) = I_o(j\omega) / U_i(j\omega)$$

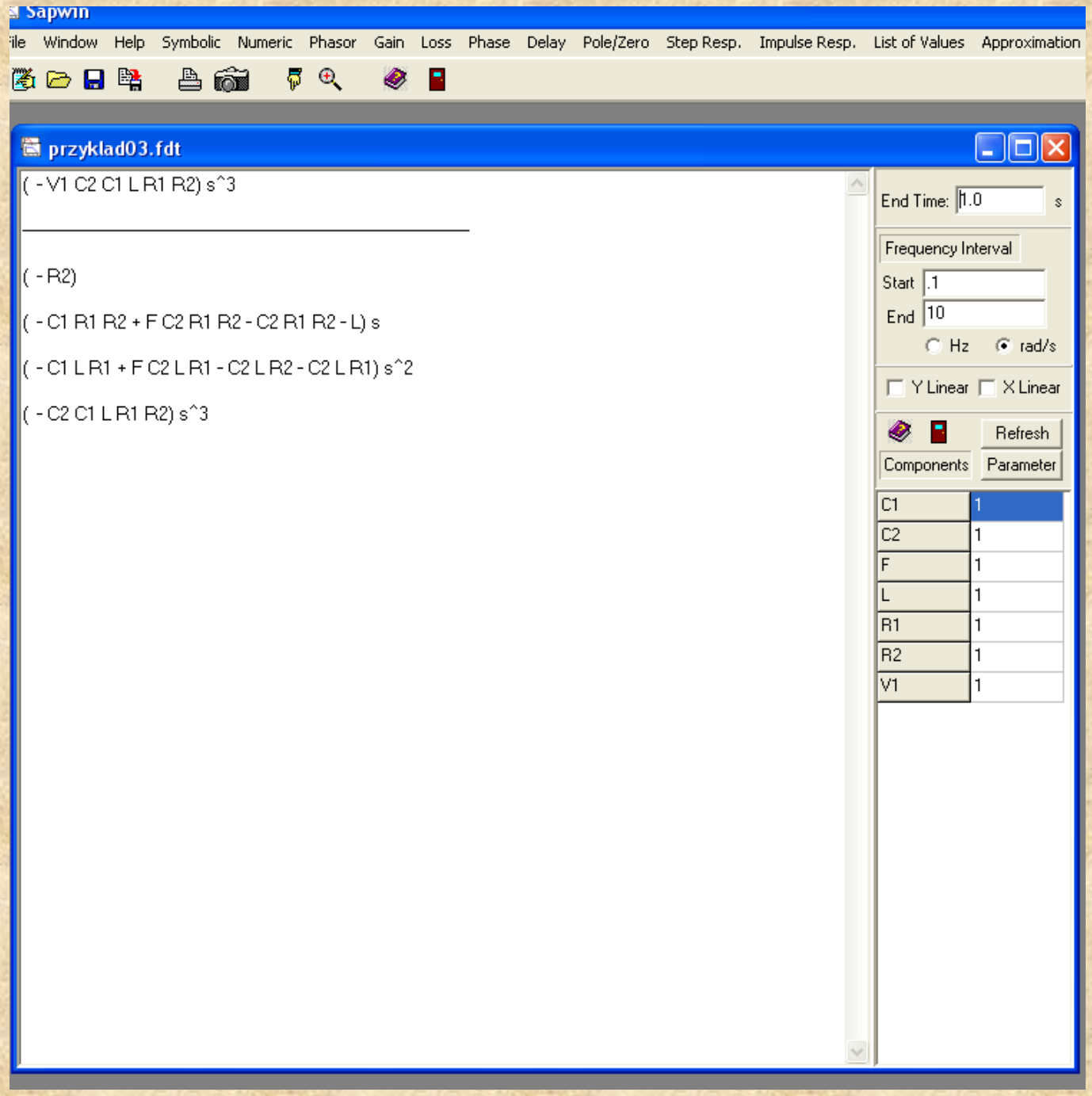
$$R_1 = 1,\ R_2 = 1,\ C_1 = C_2 = 1, L = 1,\ \alpha = 1.$$

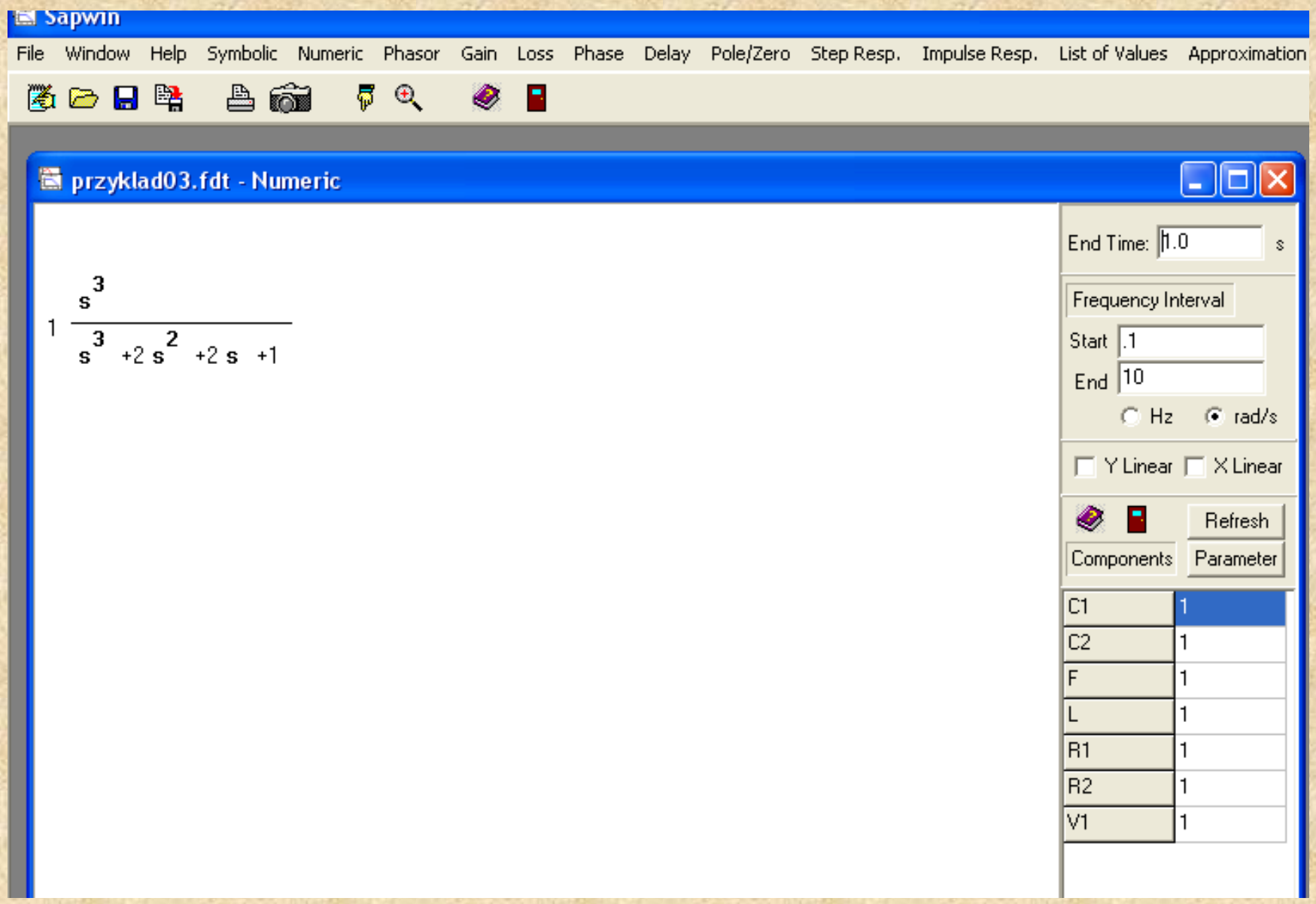


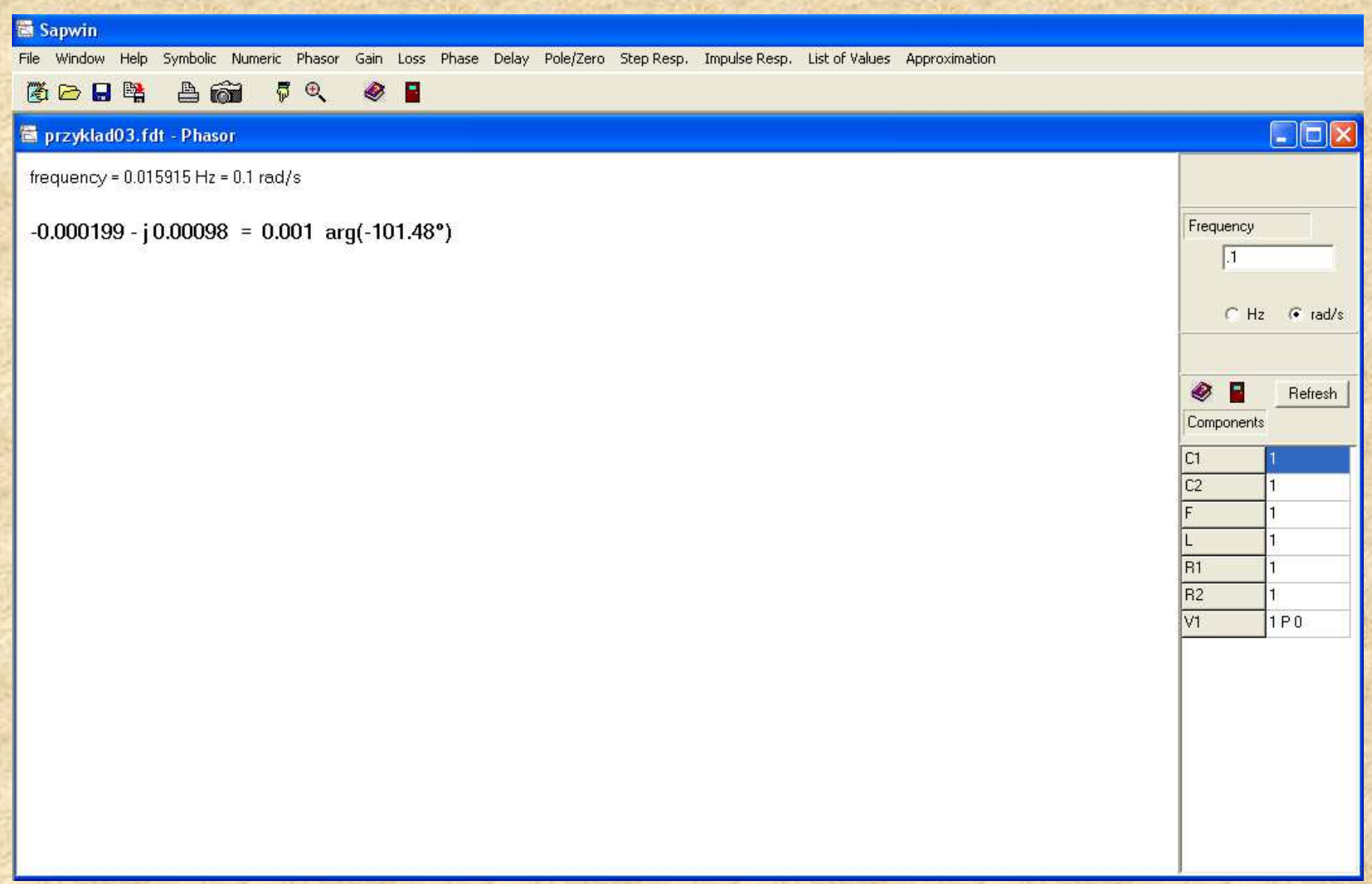
SAPWIN

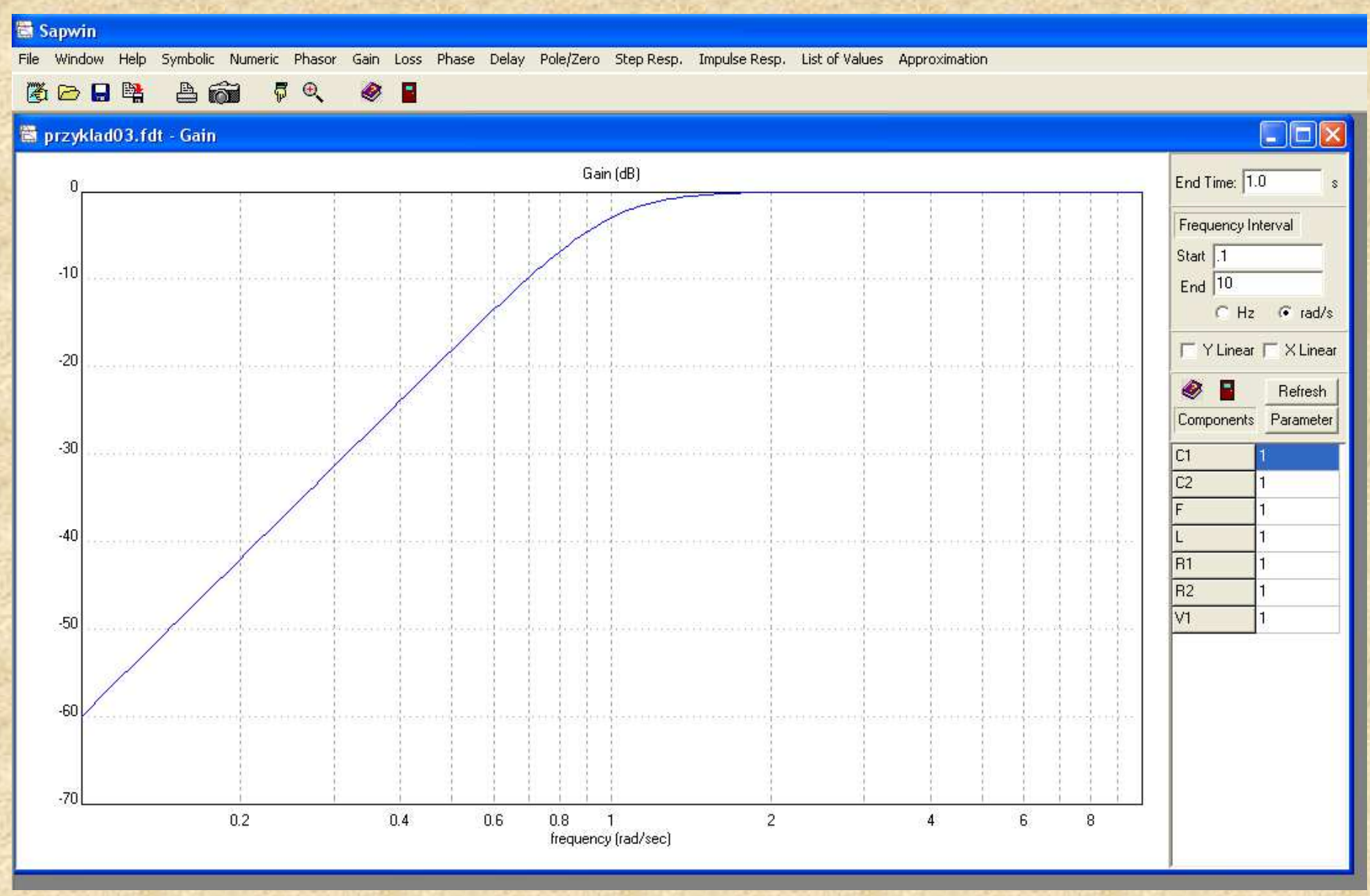
A teraz rozwiążemy ten przykład za pomocą programu komputerowego SapWin

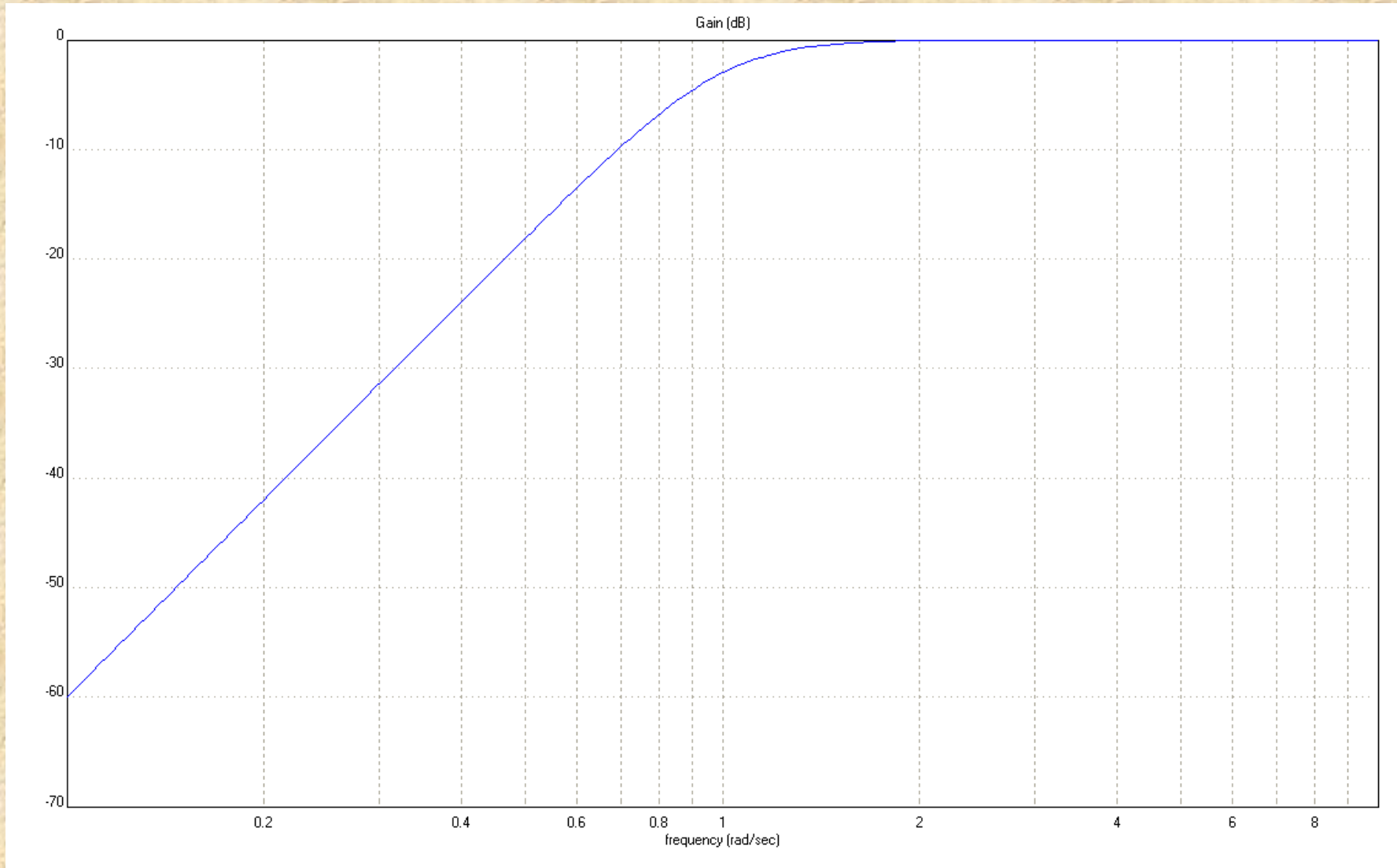

Sapwin - [Schema: C:\Program Files\SapWin\SapWin3\przyklad03.sch]
File
Window
Help
Get
Edit
Analysis
Spice Netlist
SP OA
C1
C2
V1
R1
F
L
R2

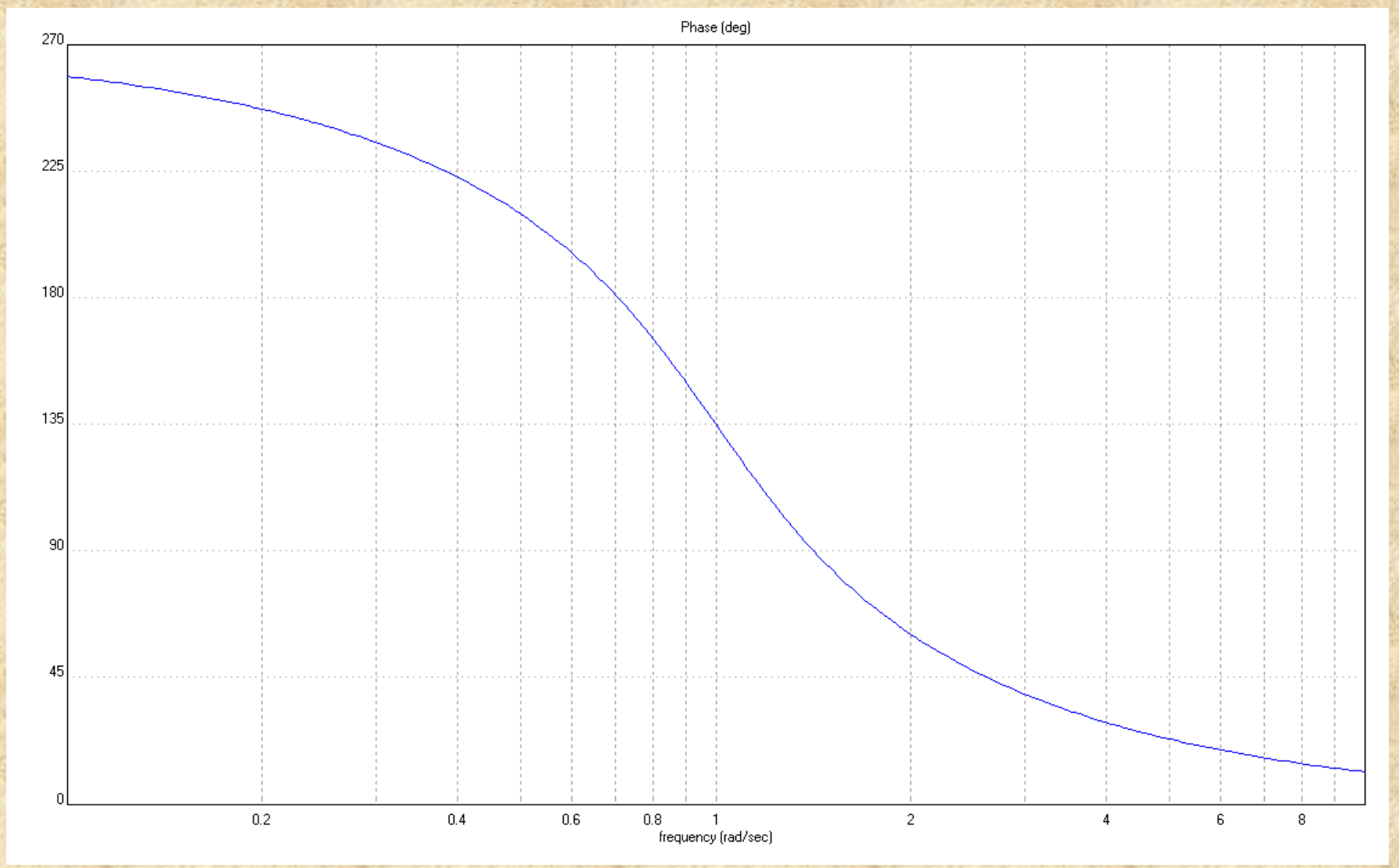

Sapwin
File Window Help Symbolic Numeric Phasor Gain Loss Phase Delay Pole/Zero Step Resp. Impulse Resp. List of Values Approximation
przyklad03.fdt
(- V1 C2 C1 L R1 R2) s^3
(- R2)
(- C1 R1 R2 + F C2 R1 R2 - C2 R1 R2 - L) s
(- C1 L R1 + F C2 L R1 - C2 L R2 - C2 L R1) s^2
(- C2 C1 L R1 R2) s^3
End Time: 1.0 s
Frequency Interval
Start .1
End 10
Hz rad/s
Y Linear X Linear
Refresh
Components Parameter
C1 1
C2 1
F 1
L 1
R1 1
R2 1
V1 1

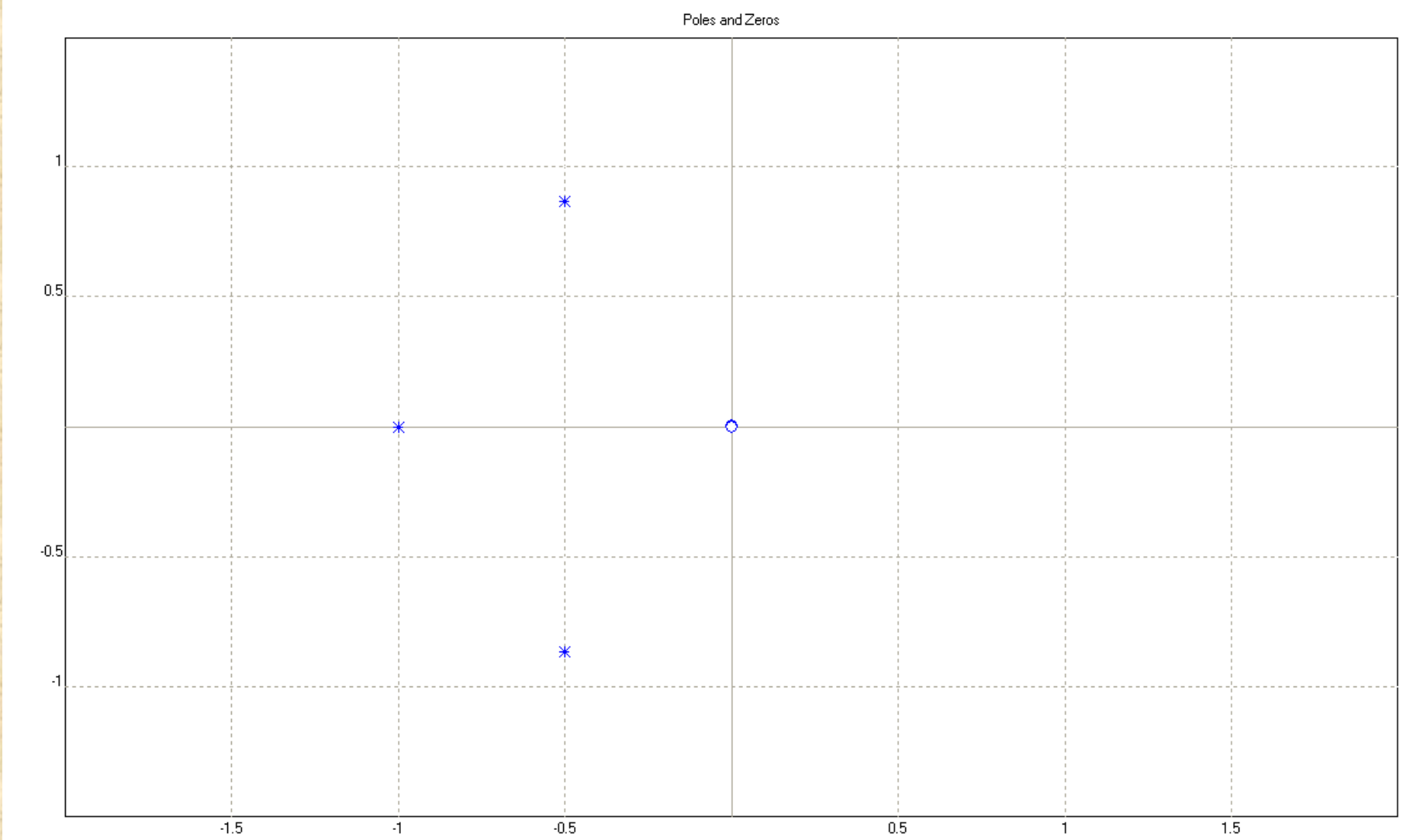

Sapwin
File Window Help Symbolic Numeric Phasor Gain Loss Phase Delay Pole/Zero Step Resp. Impulse Resp. List of Values Approximation
przyklad03.fdt - Numeric
1 s^3 / s^3 +2 s^2 +2 s +1
End Time: 1.0 s
Frequency Interval
Start .1
End 10
Hz rad/s
Y Linear X Linear
Refresh
Components Parameter
C1 1
C2 1
F 1
L 1
R1 1
R2 1
V1 1

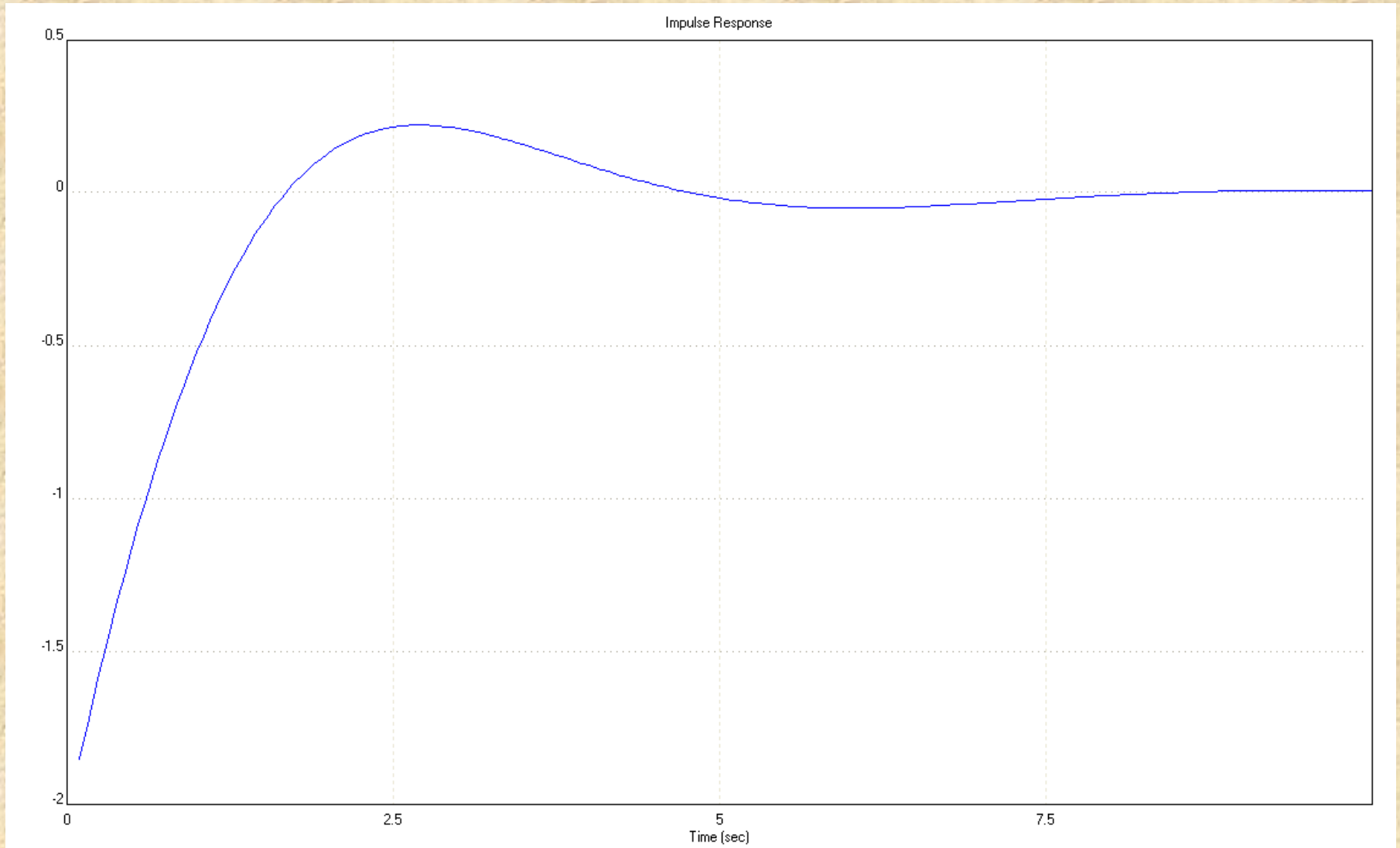

Sapwin
File Window Help Symbolic Numeric Phasor Gain Loss Phase Delay Pole/Zero Step Resp. Impulse Resp. List of Values Approximation
przyklad03.fdt - Phasor
frequency = 0.015915 Hz = 0.1 rad/s
-0.000199 - j 0.00098 = 0.001 arg(-101.48°)
Frequency
.1
Hz
rad/s
Refresh
Components
C1 1
C2 1
F 1
L 1
R1 1
R2 1
V1 1 P 0

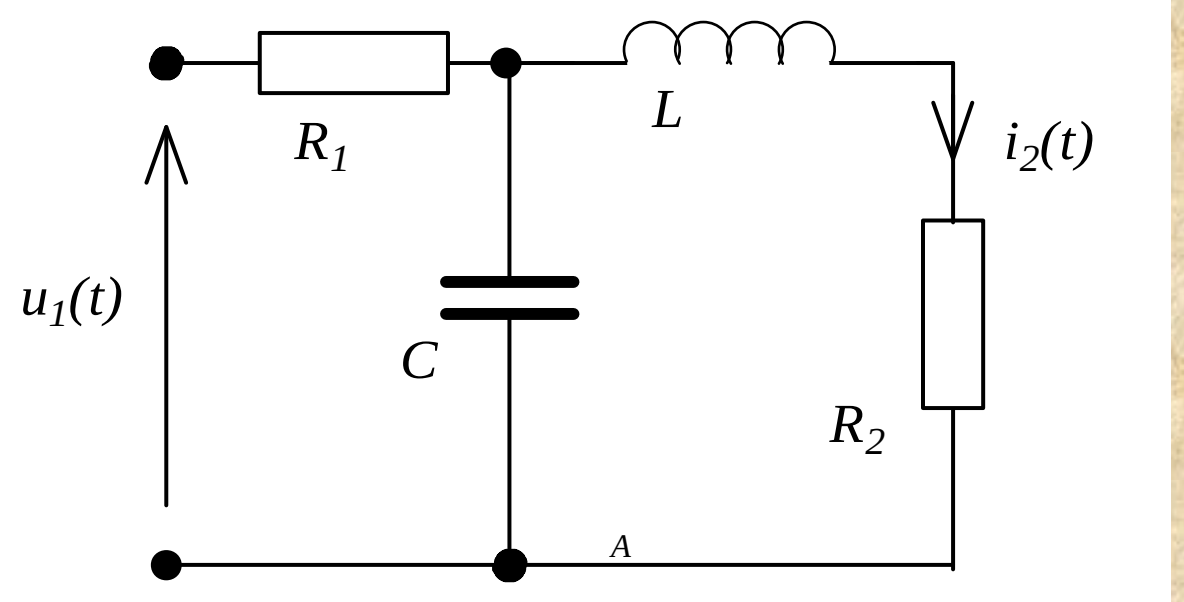

Sapwin
File Window Help Symbolic Numeric Phasor Gain Loss Phase Delay Pole/Zero Step Resp. Impulse Resp. List of Values Approximation
przyklad03.fdt - Gain
Gain (dB)
0
-10
-20
-30
-40
-50
-60
-70
0.2
0.4
0.6
0.8
1
2
4
6
8
frequency (rad/sec)
End Time: 1.0 s
Frequency Interval
Start .1
End 10
Hz
rad/s
Y Linear
X Linear
Refresh
Components
Parameter
C1 1
C2 1
F 1
L 1
R1 1
R2 1
V1 1


Gain (dB)
0
-10
-20
-30
-40
-50
-60
-70
0.2
0.4
0.6
0.8
1
2
4
6
8
frequency (rad/sec)


Phase (deg)
270
225
180
135
90
45
0
0.2
0.4
0.6
0.8
1
2
4
6
8
frequency (rad/sec)


Poles and Zeros
1
0.5
-0.5
-1
-1.5
-1
-0.5
0.5
1
1.5

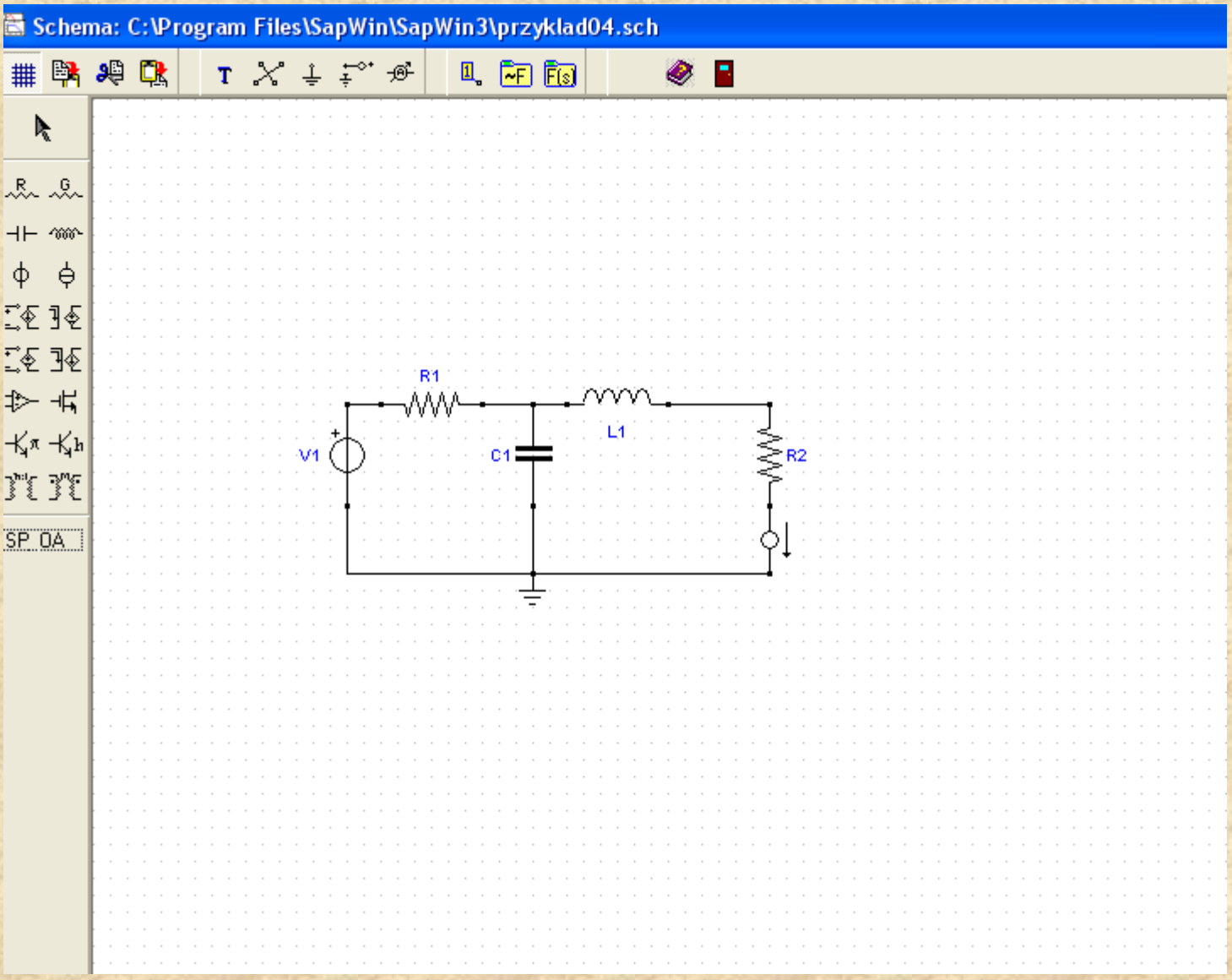

Impulse Response
0.5
0
-0.5
-1
-1.5
-2
0
2.5
5
7.5
Time (sec)

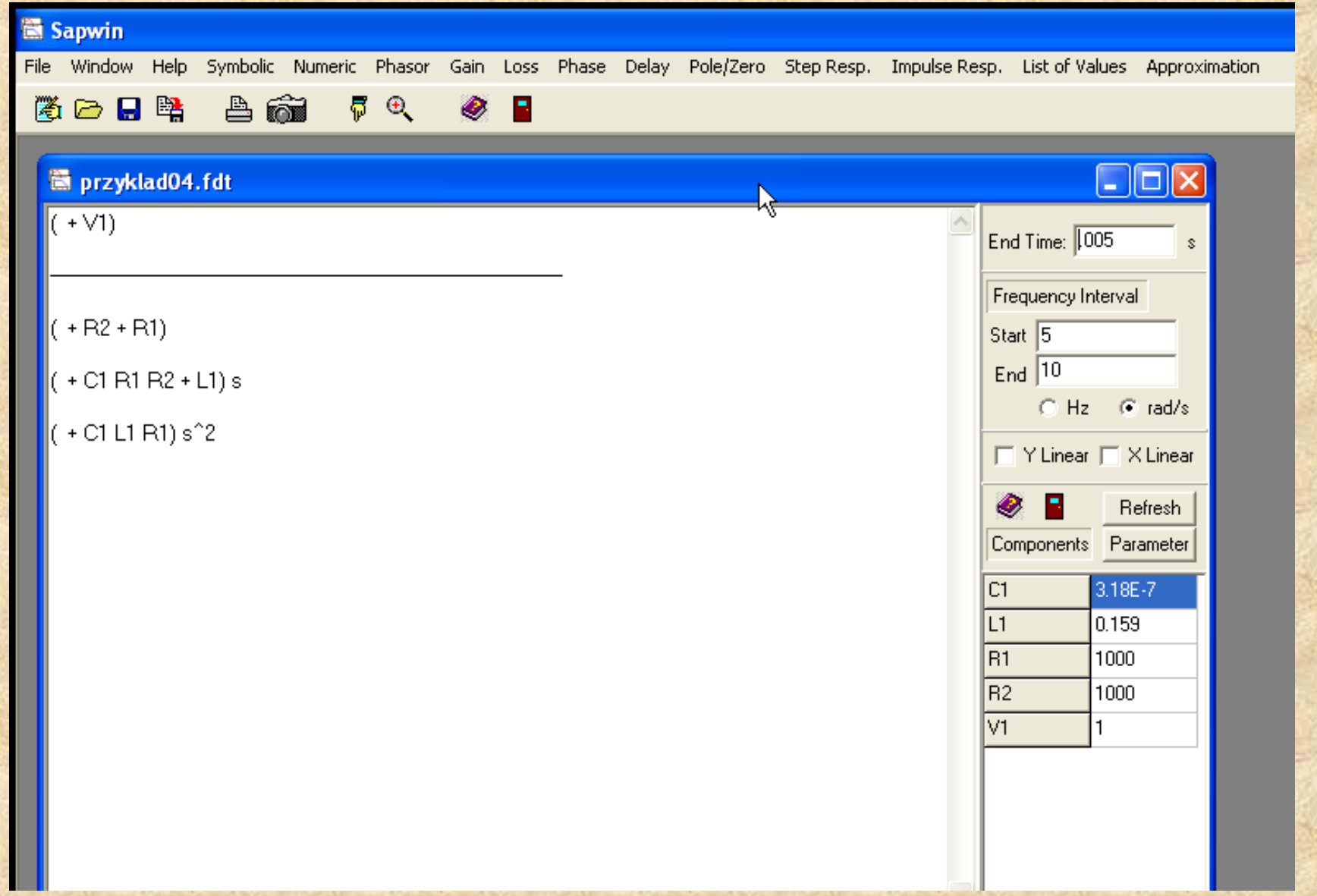


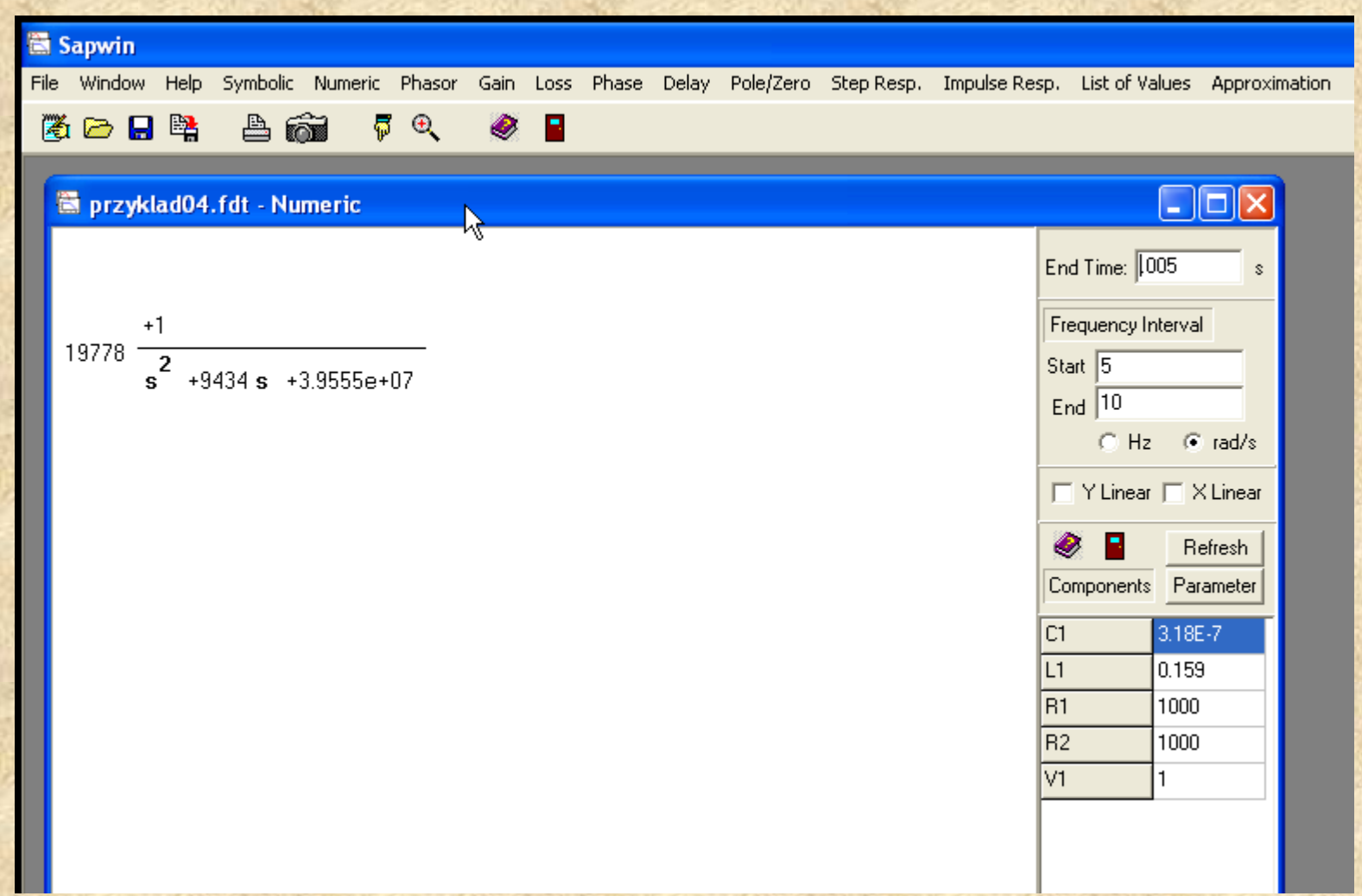
$$R_1 = 1k\Omega, R_2 = 1k\Omega, C = 318nF, L = 159mH.$$

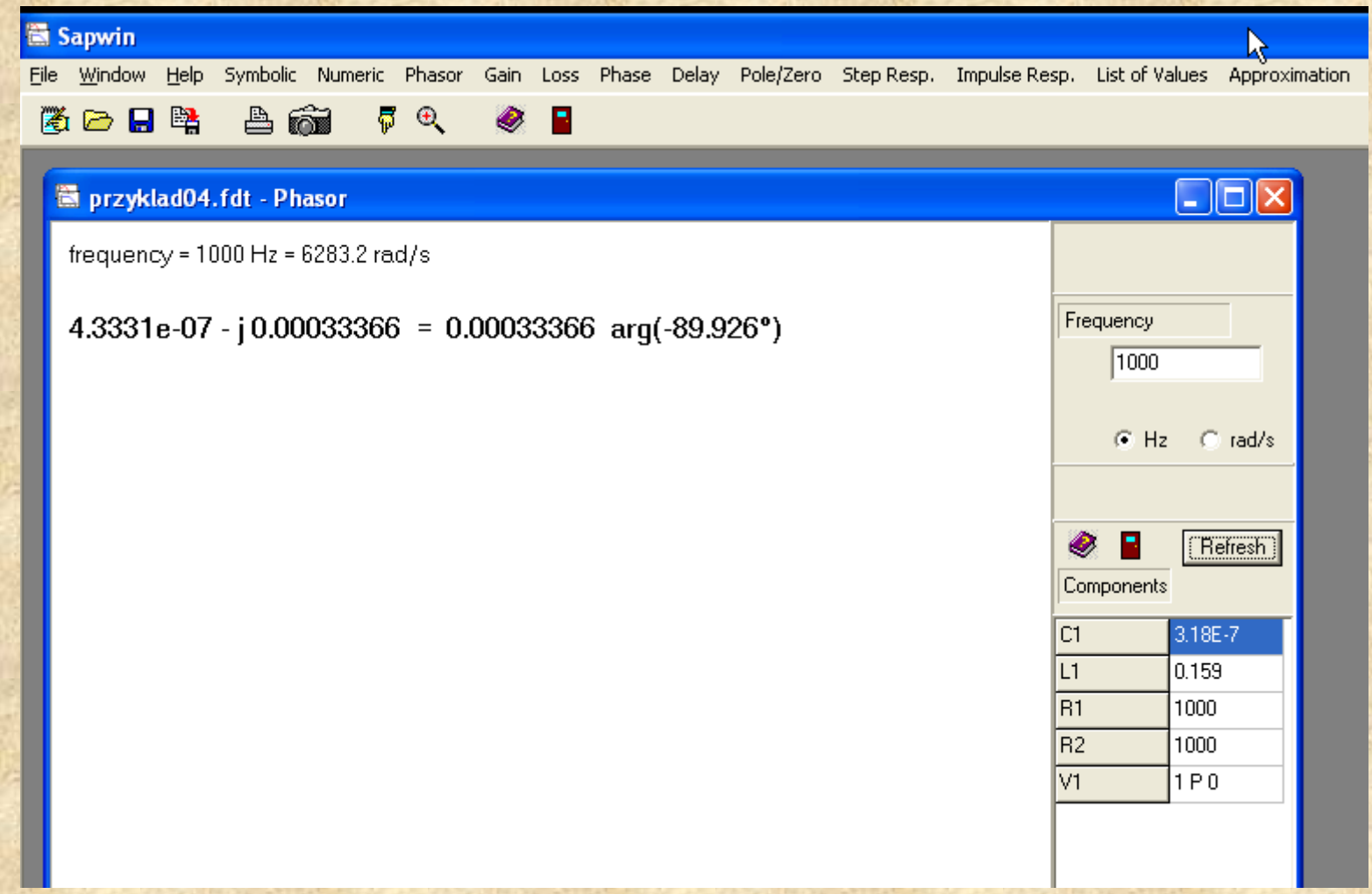
Wyznaczyć i wykreślić widmowe charakterystyki: amplitudową $A(2\pi f)$ i fazową układu $\varphi(2\pi f)$, jeżeli:

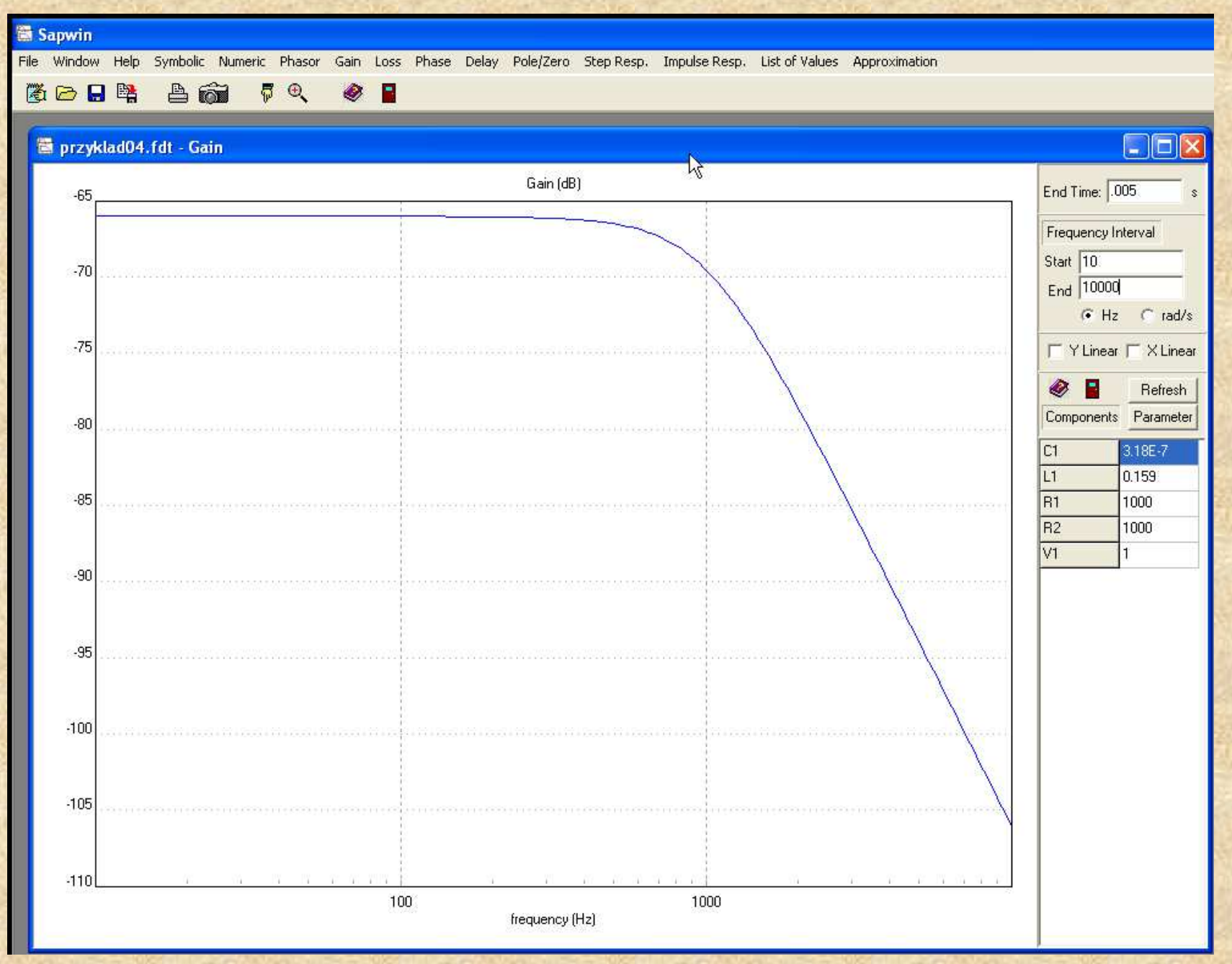
$$p(t) = u_1(t), \quad r(t) = i_2(t)$$

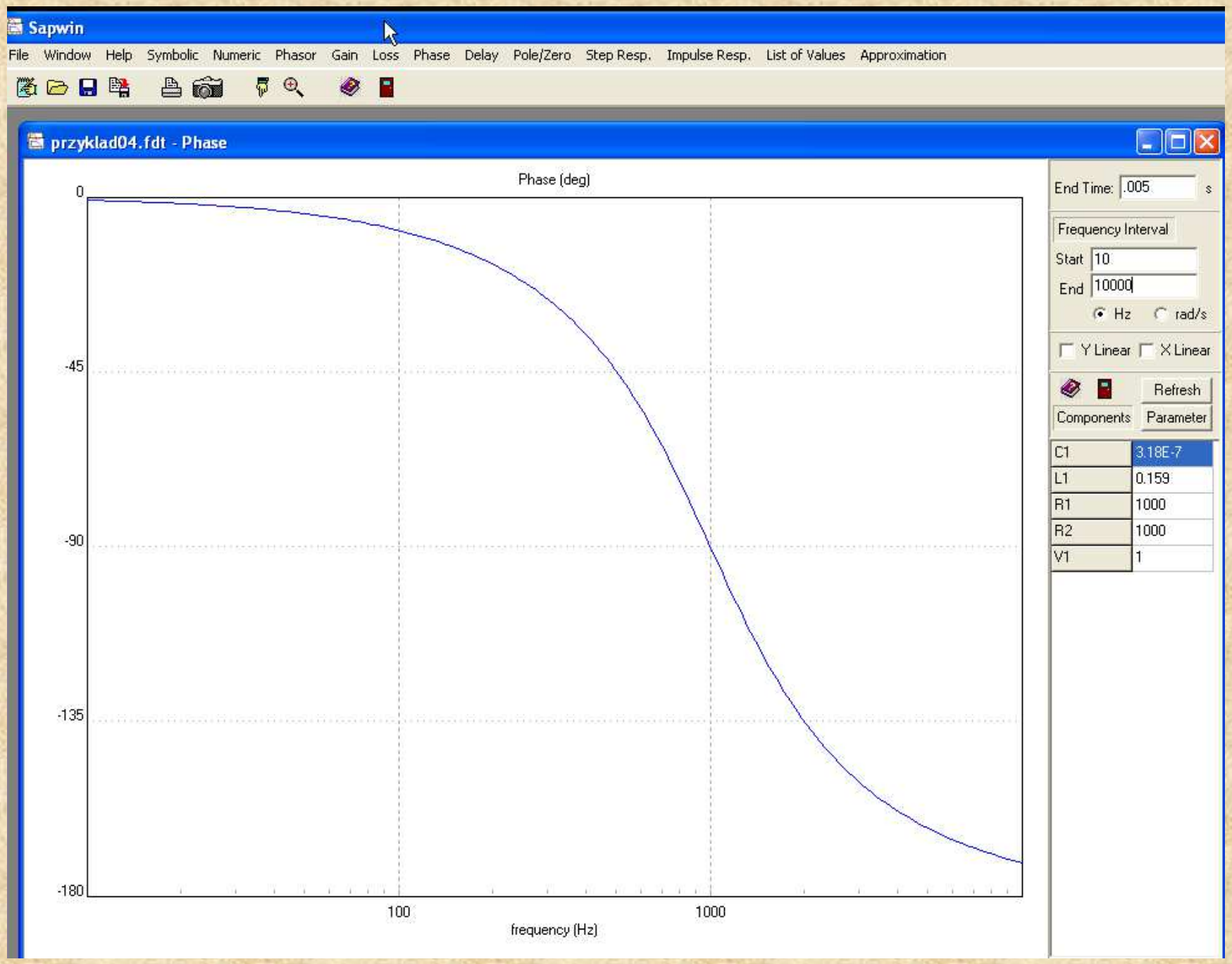

Schema: C:\Program Files\SapWin\SapWin3\przyklad04.sch
R1
L1
V1
C1
R2
SP OA

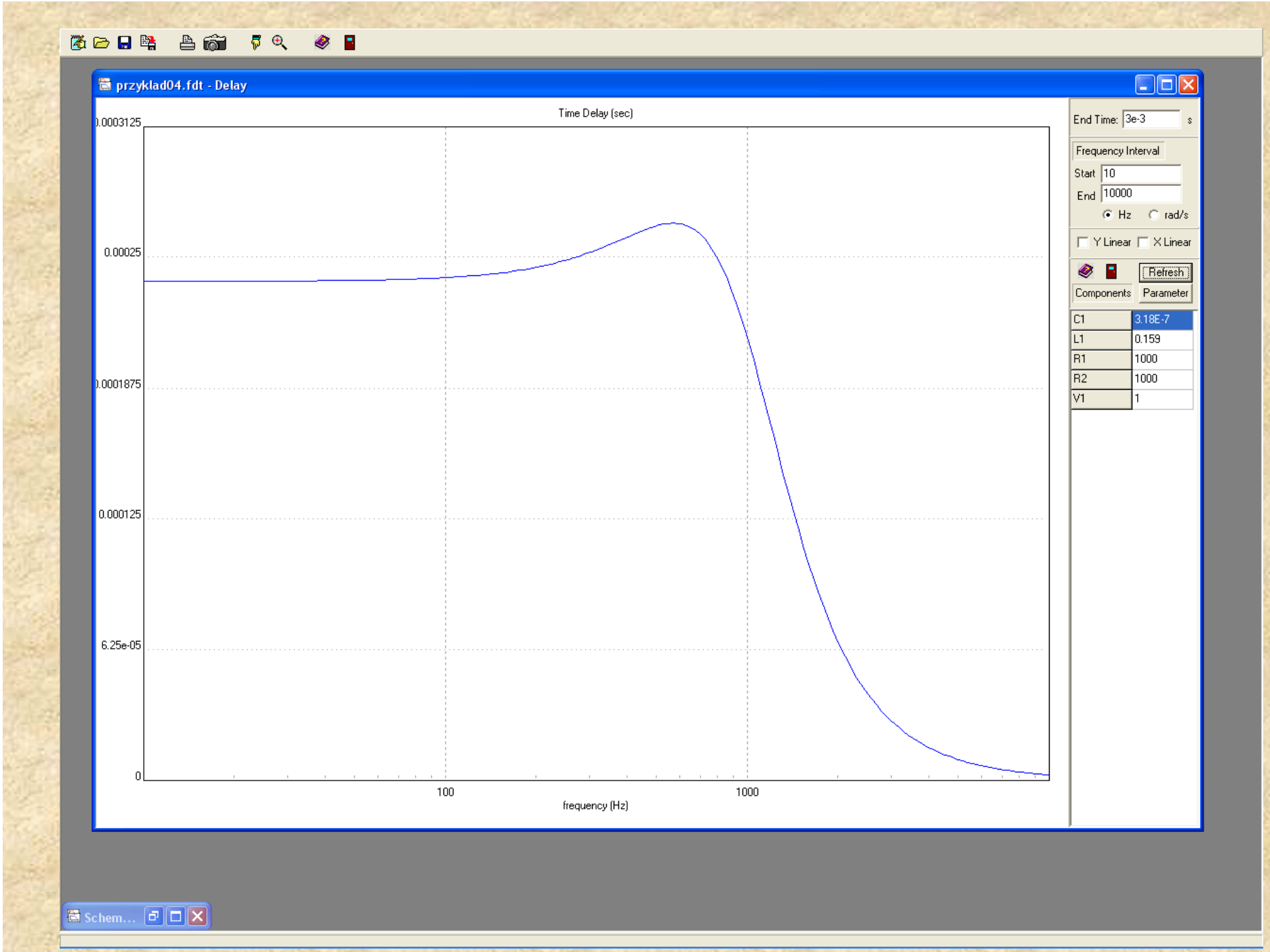

Sapwin
File Window Help Symbolic Numeric Phasor Gain Loss Phase Delay Pole/Zero Step Resp. Impulse Resp. List of Values Approximation
przyklad04.fdt
(+ V1)
(+ R2 + R1)
(+ C1 R1 R2 + L1) s
(+ C1 L1 R1) s^2
End Time: 1005 s
Frequency Interval
Start 5
End 10
Hz rad/s
Y Linear X Linear
Refresh
Components Parameter
C1 3.18E-7
L1 0.159
R1 1000
R2 1000
V1 1

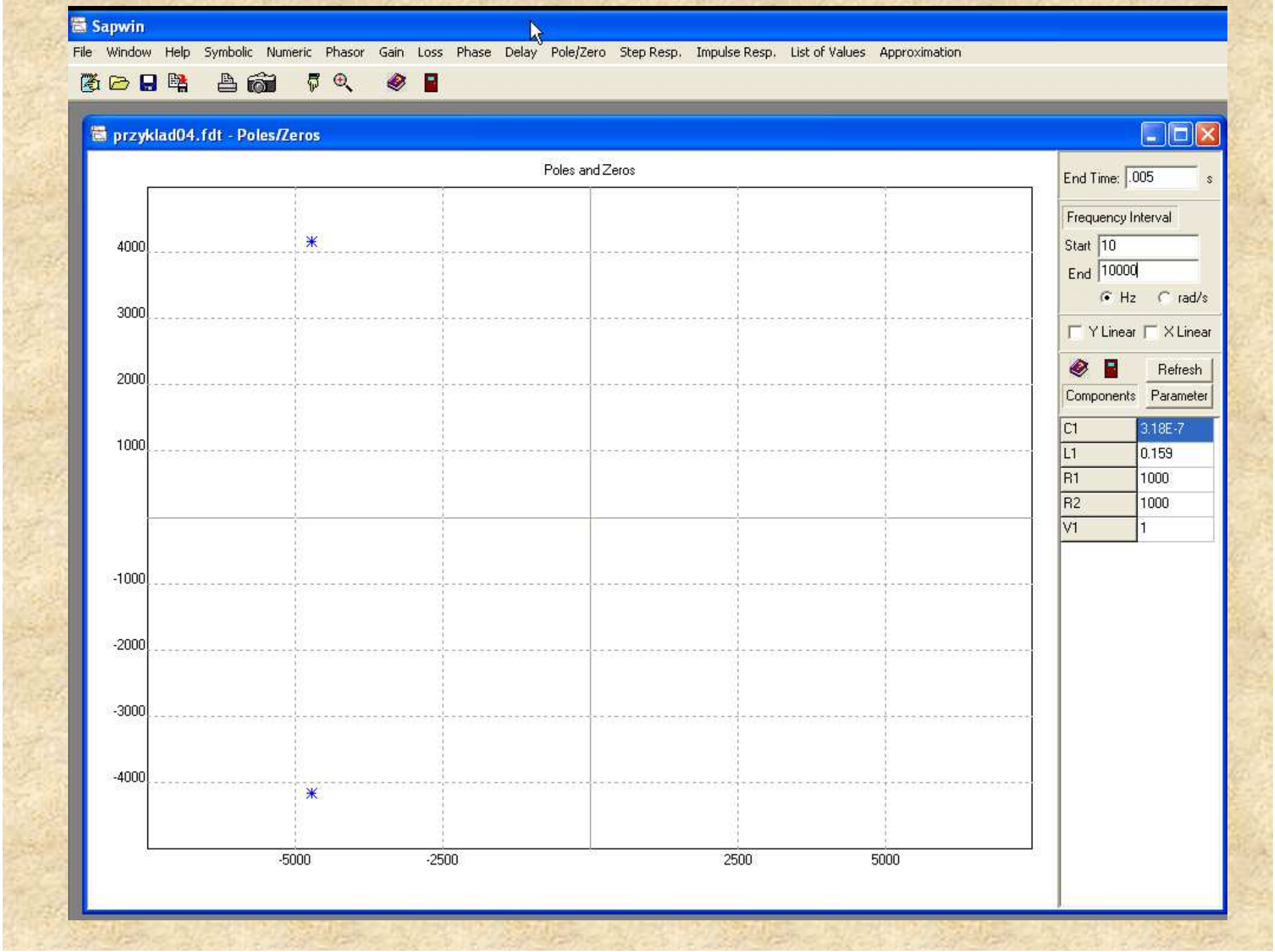

Sapwin
File Window Help Symbolic Numeric Phasor Gain Loss Phase Delay Pole/Zero Step Resp. Impulse Resp. List of Values Approximation
przyklad04.fdt - Numeric
19778 +1 / s^2 +9434 s +3.9555e+07
End Time: 005 s
Frequency Interval
Start 5
End 10
Hz rad/s
Y Linear X Linear
Refresh
Components Parameter
C1 3.18E-7
L1 0.159
R1 1000
R2 1000
V1 1

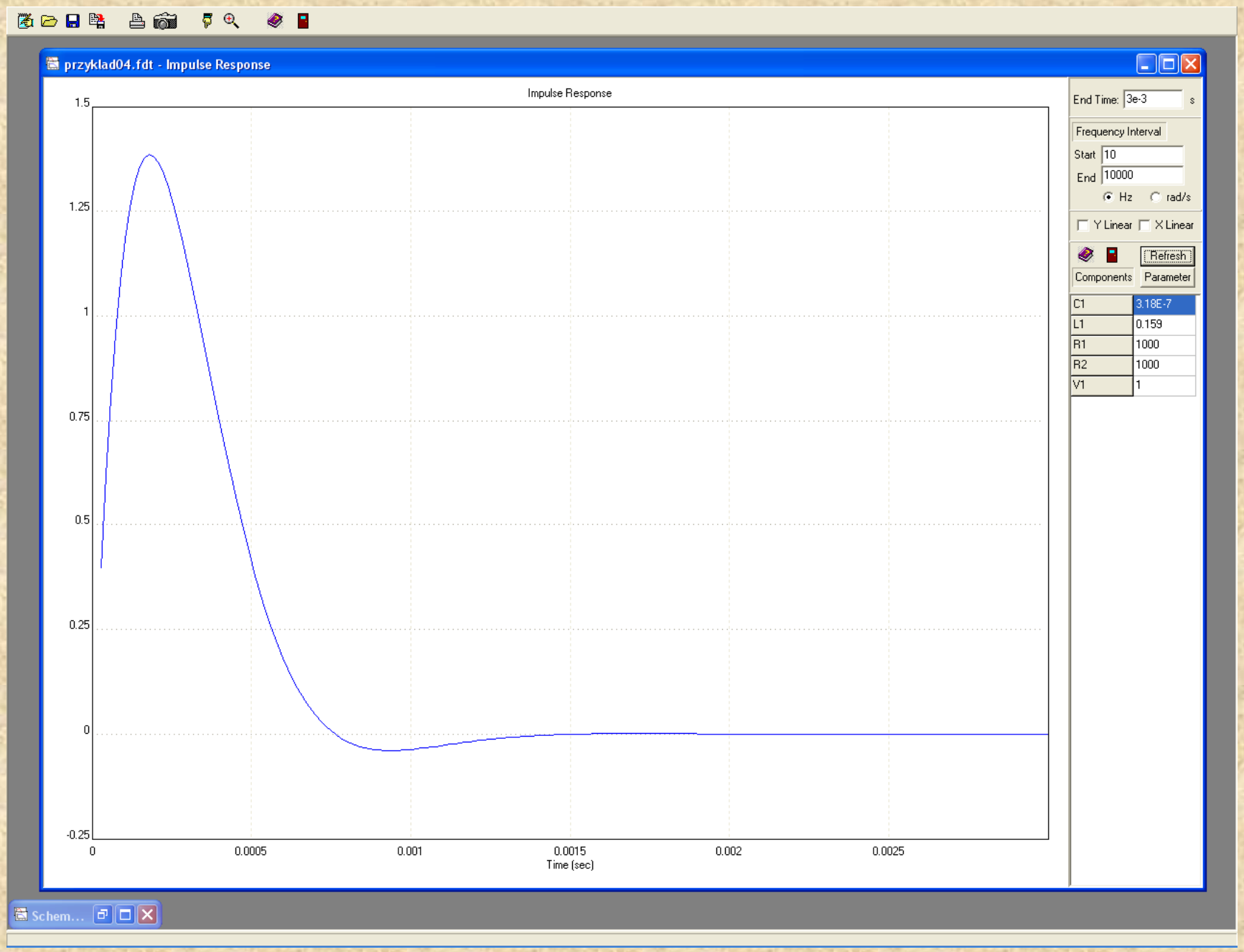

Sapwin
File Window Help Symbolic Numeric Phasor Gain Loss Phase Delay Pole/Zero Step Resp. Impulse Resp. List of Values Approximation
przyklad04.fdt - Phasor
frequency = 1000 Hz = 6283.2 rad/s
4.3331e-07 - j 0.00033366 = 0.00033366 arg(-89.926°)
Frequency
1000
Hz
rad/s
Refresh
Components
C1 3.18E-7
L1 0.159
R1 1000
R2 1000
V1 1 P 0

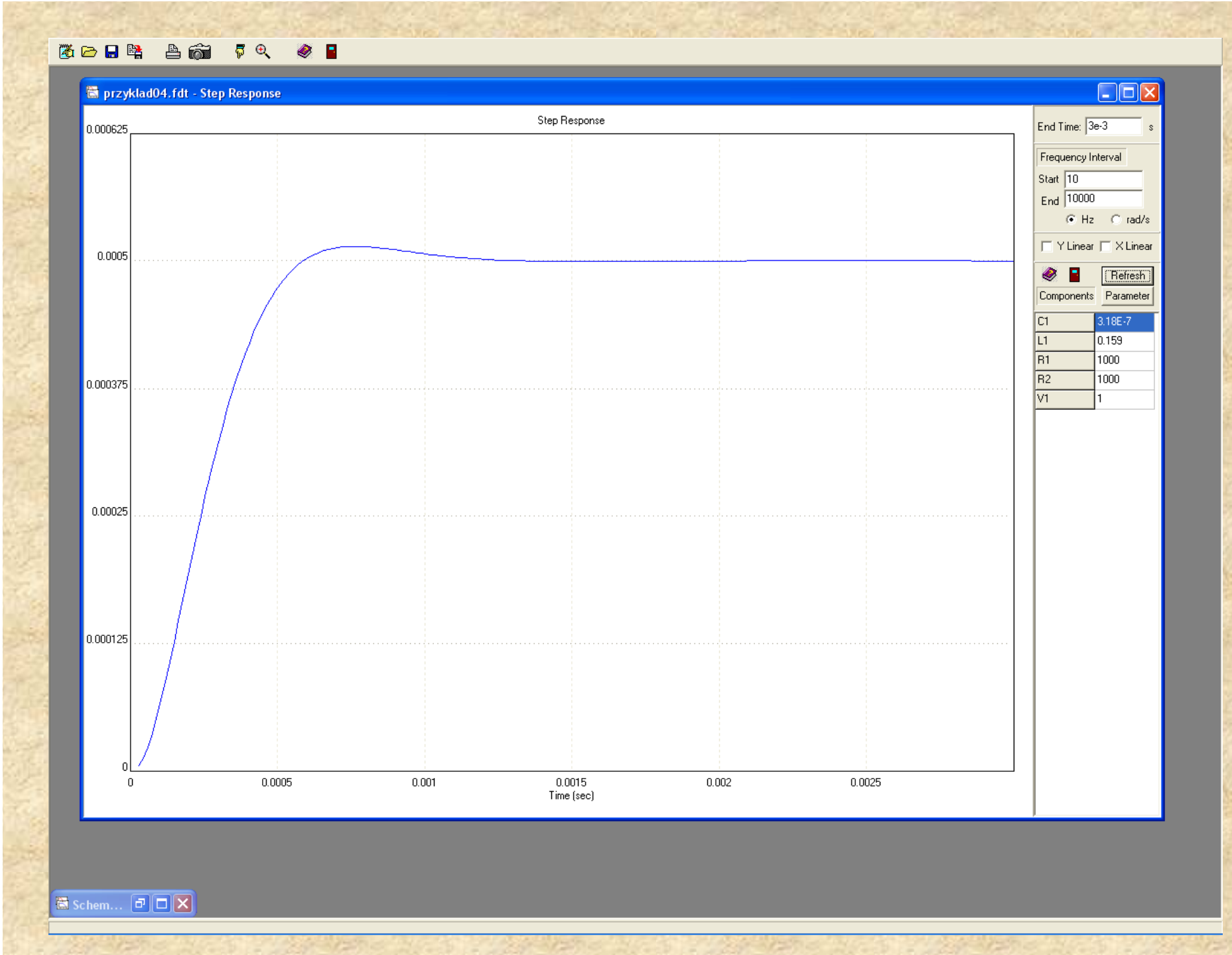

Sapwin
File Window Help Symbolic Numeric Phasor Gain Loss Phase Delay Pole/Zero Step Resp. Impulse Resp. List of Values Approximation
przyklad04.fdt - Gain
Gain (dB)
-65
-70
-75
-80
-85
-90
-95
-100
-105
-110
100
1000
frequency (Hz)
End Time: .005 s
Frequency Interval
Start 10
End 10000
Hz rad/s
Y Linear X Linear
Refresh
Components Parameter
C1 3.18E-7
L1 0.159
R1 1000
R2 1000
V1 1


Sapwin
File Window Help Symbolic Numeric Phasor Gain Loss Phase Delay Pole/Zero Step Resp. Impulse Resp. List of Values Approximation
przyklad04.fdt - Phase
Phase (deg)
0
-45
-90
-135
-180
100
1000
frequency (Hz)
End Time: .005 s
Frequency Interval
Start 10
End 10000
Hz rad/s
Y Linear X Linear
Refresh
Components Parameter
C1 3.18E-7
L1 0.159
R1 1000
R2 1000
V1 1


przyklad04.fdt - Delay
Time Delay (sec)
0.0003125
0.00025
0.0001875
0.000125
6.25e-05
0
100
1000
frequency (Hz)
End Time: 3e-3 s
Frequency Interval
Start 10
End 10000
Hz
rad/s
Y Linear
X Linear
Refresh
Components
Parameter
C1 3.18E-7
L1 0.159
R1 1000
R2 1000
V1 1
Schem...


Sapwin
File Window Help Symbolic Numeric Phasor Gain Loss Phase Delay Pole/Zero Step Resp. Impulse Resp. List of Values Approximation
przyklad04.fdt - Poles/Zeros
Poles and Zeros
4000
3000
2000
1000
-1000
-2000
-3000
-4000
-5000
-2500
2500
5000
End Time: .005 s
Frequency Interval
Start 10
End 10000
Hz rad/s
Y Linear X Linear
Refresh
Components Parameter
C1 3.18E-7
L1 0.159
R1 1000
R2 1000
V1 1


przyklad04.fdt - Impulse Response
Impulse Response
1.5
1.25
1
0.75
0.5
0.25
0
-0.25
0
0.0005
0.001
0.0015
0.002
0.0025
Time (sec)
End Time: 3e-3 s
Frequency Interval
Start 10
End 10000
Hz
rad/s
Y Linear
X Linear
Refresh
Components
Parameter
C1 3.18E-7
L1 0.159
R1 1000
R2 1000
V1 1
Schem...


przyklad04.fdt - Step Response
Step Response
0.000625
0.0005
0.000375
0.00025
0.000125
0
0
0.0005
0.001
0.0015
0.002
0.0025
Time (sec)
End Time: 3e-3 s
Frequency Interval
Start 10
End 10000
Hz
rad/s
Y Linear
X Linear
Refresh
Components
Parameter
C1 3.18E-7
L1 0.159
R1 1000
R2 1000
V1 1
Schem...