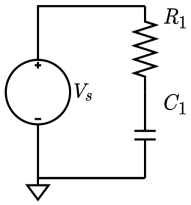
Resistor-Capacitor circuits

1. Capacitive low-pass filter

```
circuit = Circuit('circuits/rc_low_pass.txt');
circuit.list
```

```
ans =
    'Vin 1 0 DC 5
     R1 1 2 1000
     C1 2 0 0.0001
     '
```




```
ELAB.analyze(circuit)
```

```
Symbolic analysis successful (0.185505 sec).
```

Maybe you want expressions for node voltages.

```
circuit.symbolic_node_voltages
```

```
ans =
```

$$\begin{pmatrix} v_1 = \mathrm{Vin} \\ v_2 = \dfrac{\mathrm{Vin}}{C_1 R_1 s + 1} \end{pmatrix}$$

Or the numerical currents for all elements in this particular circuit in relation to the s-domain.

```
ELAB.evaluate(circuit)
```

```
Numerical evaluation successful (0.0533282 sec).
```

```
circuit.numerical_element_currents
```

```
ans =
```

$$\begin{pmatrix} i_{\mathrm{R1}} = \dfrac{s}{2000\left(\frac{s}{10}+1\right)} \\ i_{\mathrm{C1}} = \dfrac{5}{\frac{s}{100000}+\frac{1}{10000}} \end{pmatrix}$$

Say we want the numerical transfer function, where the output is the voltage across the capacitor.

```
TF = ELAB.ec2tf(circuit, 1, 2)
```

```
Transfer function object created successfully (6.358610e-02 sec).
```

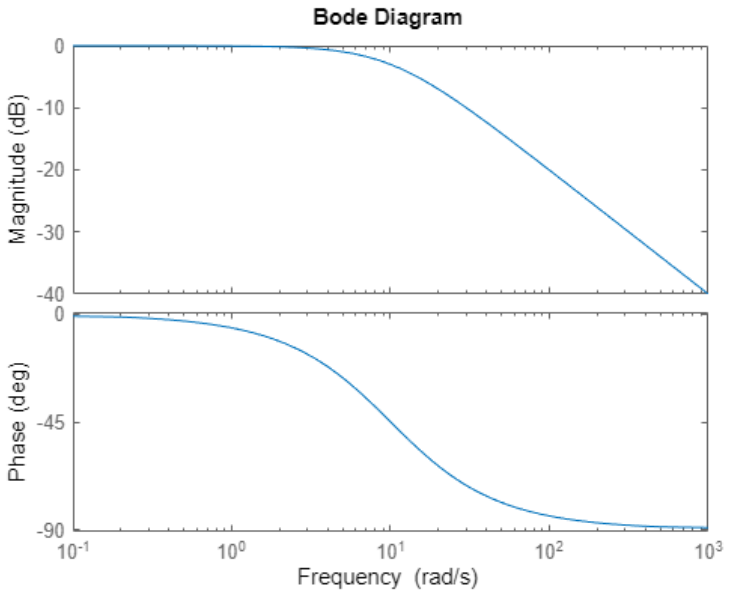
```
TF =

    10
  ------
  s + 10

Continuous-time transfer function.
```

Matlab can then be used to visualize the circuit behavior as with any other system. Plotting the Bode diagram, we see that this is infact a low-pass-filter.

```
bode(TF)
```

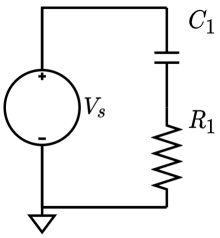


2. Capacitive high-pass filter

We can repeat the process with a variation of the circuit, where the capacitor comes before the resistor.

```
circuit = Circuit('circuits/rc_high_pass.txt');
circuit.list
```

```
ans =
    'Vin 1 0 DC 5
     R1 2 0 1000
     C1 1 2 0.0001
     '
```




```
ELAB.analyze(circuit)
```

```
Symbolic analysis successful (0.177152 sec).
```

```
circuit.symbolic_node_voltages
```

```
ans =
```

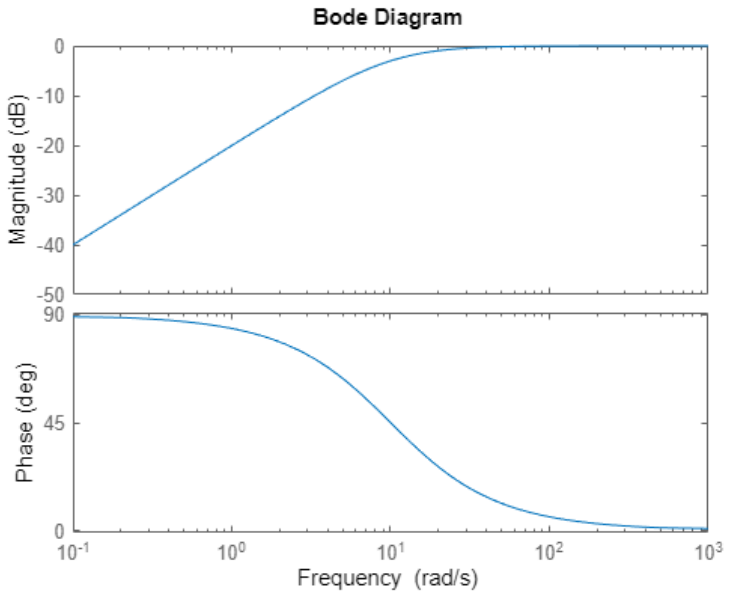
$$\begin{pmatrix} v_1 = \mathrm{Vin} \\ v_2 = \dfrac{C_1 R_1 \,\mathrm{Vin}\, s}{C_1 R_1 s + 1} \end{pmatrix}$$

```
TF = ELAB.ec2tf(circuit, 1, 2);
```

```
Numerical evaluation successful (0.0486396 sec).
Transfer function object created successfully (1.023130e-01 sec).
```

Plotting the Bode diagram, we see that this rc-configuration acts as a high-pass filter.

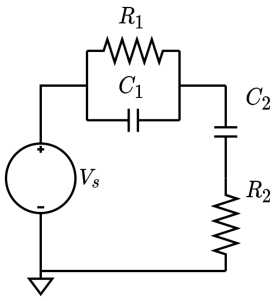
```
bode(TF)
```



3. Arbitrary RC-circuits

```
circuit = Circuit('circuits/rc_mix.txt');
circuit.list
```

```
ans =
    'Vs 1 0 AC Vs
     R1 1 2 10000
     R2 3 0 20000
     C1 1 2 0.0000001
     C2 2 3 0.00000005
     '
```




```
ELAB.analyze(circuit)
```

```
Symbolic analysis successful (0.366976 sec).
```

```
ELAB.ec2sd(circuit,1,2)
```

```
Symbolic transfer function calculated successfully (4.485800e-03 sec).
ans =
```

$$\frac{v_2}{v_1} = \frac{(C_1 R_1 s + 1)(C_2 R_2 s + 1)}{C_1 R_1 s + C_2 R_1 s + C_2 R_2 s + C_1 C_2 R_1 R_2 s^2 + 1}$$

```
TF = ELAB.ec2tf(circuit,1,2)
```

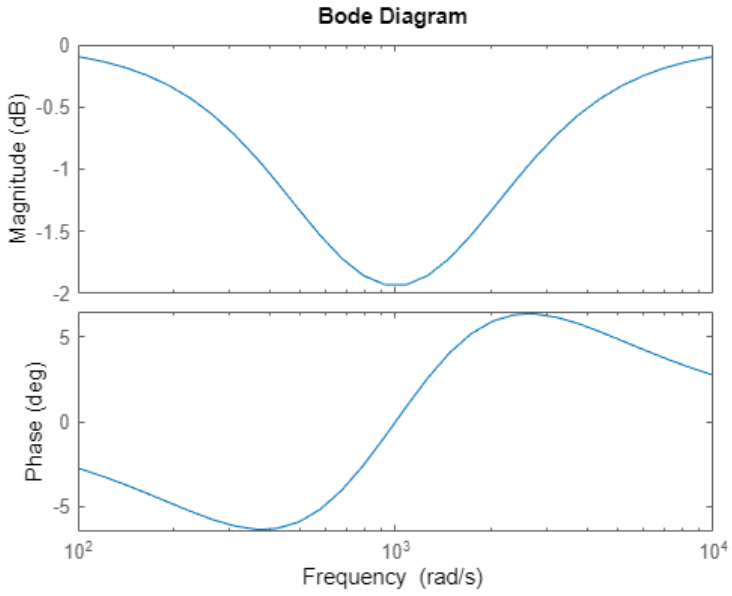
```
Numerical evaluation successful (0.136514 sec).
Transfer function object created successfully (1.971431e-01 sec).

TF =

  s^2 + 2000 s + 1e06
  -------------------
  s^2 + 2500 s + 1e06

Continuous-time transfer function.
```

```
bode(TF)
```



As is apparent from the bode-plot, this particular circuit acts as a band-stop filter.