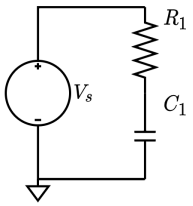
Resistor-Capacitor circuits

1. Capacitive low-pass filter

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

```
ans =
    'Vs 1 0 DC 5
     R1 1 2 10000
     C1 2 0 0.00000001
     '
```




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

```
Symbolic analysis successful (0.172581 sec).
```

Maybe you want expressions for node voltages.

```
circuit.symbolic_node_voltages
```

```
ans =
```

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

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

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

```
Numerical evaluation successful (0.0488848 sec).
```

```
circuit.numerical_element_currents
```

```
ans =
```

$$\begin{pmatrix} i_{\mathrm{R1}} = \dfrac{944473296573929\, s}{18889465931478580854784 \left(\dfrac{s}{10000} + 1\right)} \\ i_{\mathrm{C1}} = \dfrac{5}{\dfrac{s}{1000000000000} + \dfrac{1}{100000000}} \end{pmatrix}$$

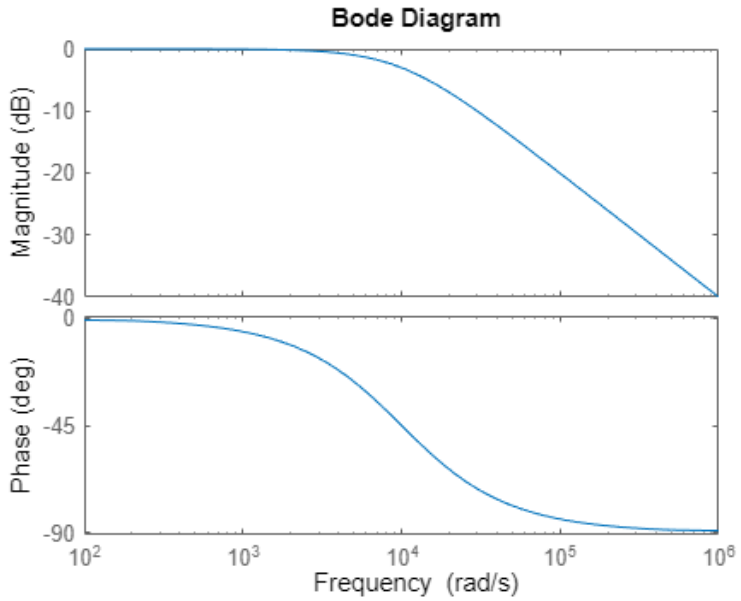
Say we want the numerical transfer function, where the output is the voltage across the capacitor.

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

```
Transfer function object created successfully (1.804110e-02 sec).

TF =

    10000
  ---------
  s + 10000

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)
```

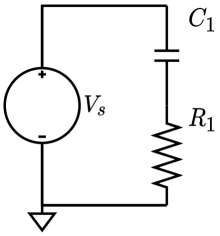


2. Capacitive high-pass filter

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 (0.191702 sec).
```

```
circuit.symbolic_node_voltages
```

```
ans =
```

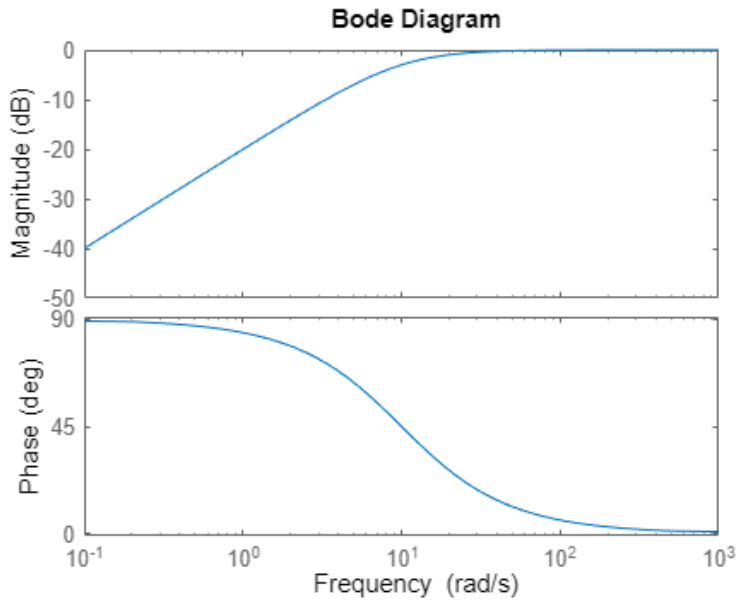
$$\begin{pmatrix} v_1 = \mathrm{Vin} \\ v_2 = \dfrac{C_1 R_1 \,\mathrm{Vin}\, s}{C_1 R_1 s + 1} \end{pmatrix}$$

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

```
Numerical evaluation successful (0.0541597 sec).
Transfer function object created successfully (8.216440e-02 sec).
```

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

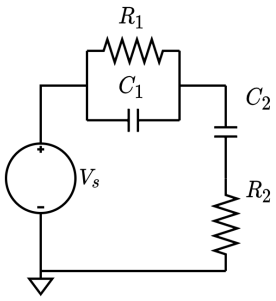
```
bode(TF)
```



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 (0.363541 sec).
```

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

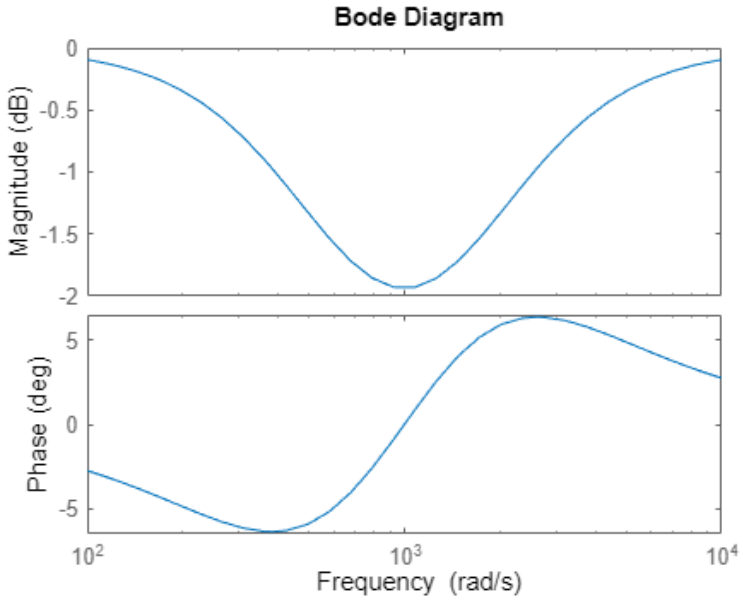
```
Symbolic transfer function calculated successfully (4.485800e-03 sec).
ans =
```

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

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

```
Numerical evaluation successful (0.122718 sec).
Transfer function object created successfully (1.610850e-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.