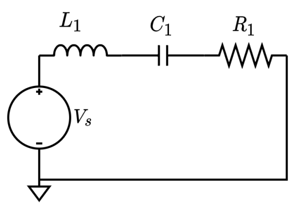
Resistor-Inductor-Capacitor circuits

1. Series RLC

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

```
ans =
    'Vin 1 0 DC 5
     R1 3 0 1000
     L1 1 2 1
     C1 2 3 0.0001
     '
```




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

```
Symbolic analysis successful (0.303556 sec).
```

Say, you want expressions for node voltages.

```
circuit.symbolic_node_voltages
```

ans =

$$\begin{pmatrix} v_1 = \mathrm{Vin} \\ v_2 = \dfrac{\mathrm{Vin}\ (C_1 R_1 s + 1)}{C_1 L_1 s^2 + C_1 R_1 s + 1} \\ v_3 = \dfrac{C_1 R_1 \mathrm{Vin}\, s}{C_1 L_1 s^2 + C_1 R_1 s + 1} \end{pmatrix}$$

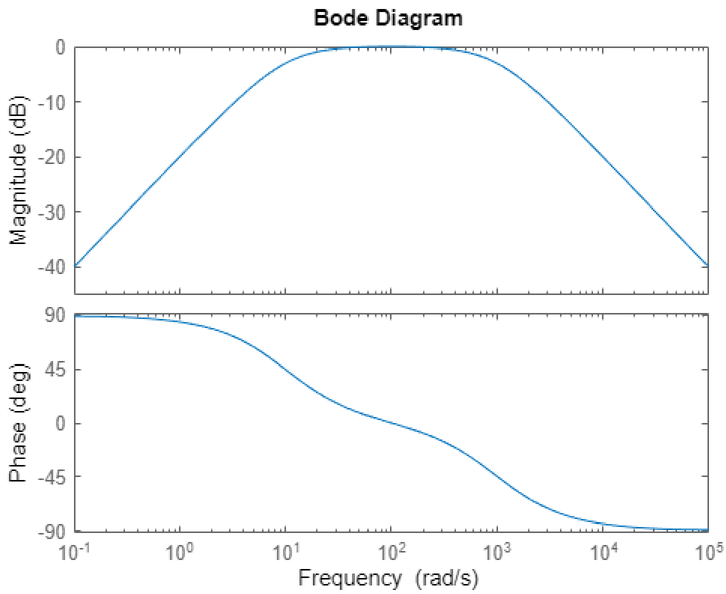
From the circuit, you can easily create a transfer function object, only giving the input and output nodes.

```
TF = ELAB.ec2tf(circuit, 1, 3)
```

```
Numerical evaluation successful (0.0884171 sec).
Transfer function object created successfully (1.278059e-01 sec).

TF =

         1000 s
  --------------------
  s^2 + 1000 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 circuit acts as a band-pass-filter.

```
bode(TF)
```

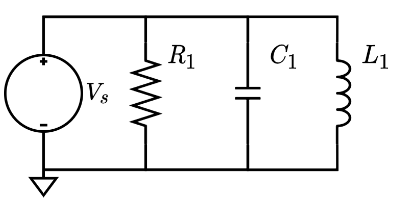


2. Parallel RLC

We can repeat the process to look at RLC in parallel.

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

```
ans =
    'Iin 1 0 DC 2
     R1 1 0 1000
     L1 1 0 1
     C1 1 0 0.0001
     '
```




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

```
Symbolic analysis successful (0.20026 sec).
```

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

```
Numerical evaluation successful (0.0448269 sec).
```

In this case, because there is only one node besides ground, the transfer function is just the voltage at node 1.

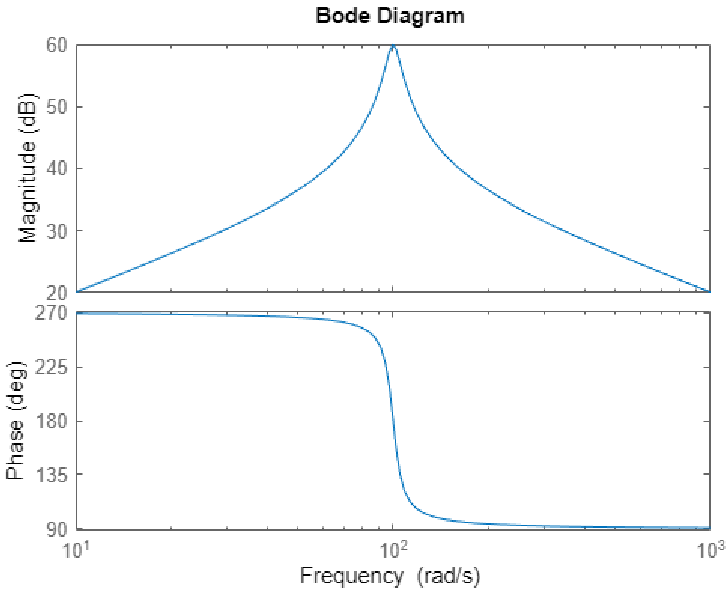
```
circuit.numerical_node_voltages(1)
```

```
ans =
```

$$v_1 = -\frac{2000\,s}{\frac{s^2}{10} + s + 1000}$$

You can of course input the equation directly into Matlab's transfer function. Plotting the Bode diagram show that this is another kind of band-pass-filter.

```
s = tf('s');
TF = -(1000*s)/(s^2/10 + s + 1000);
bode(TF)
```

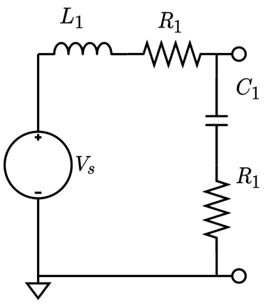


Feel free to try any combination of resistors, capacitors and inductors.

3. Arbitrary RLC-circuits

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

```
ans =
    'Vs 1 0 AC Vs
     R1 2 3 1000
     R2 4 0 1000
     L1 1 2 0.01
     C1 3 4 0.0000001
     '
```




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

```
Symbolic analysis successful (0.470365 sec).
```

```
ELAB.ec2sd(circuit,1,3)
```

```
Symbolic transfer function calculated successfully (4.440400e-03 sec).
ans =
```

$$\frac{v_3}{v_1} = \frac{C_1 R_2 s + 1}{C_1 R_1 s + C_1 R_2 s + C_1 L_1 s^2 + 1}$$

```
bode(ELAB.ec2tf(circuit,1,3))
```

```
Numerical evaluation successful (0.10732 sec).
Transfer function object created successfully (1.374029e-01 sec).
```