Programming Exercises
Mathematical Modeling

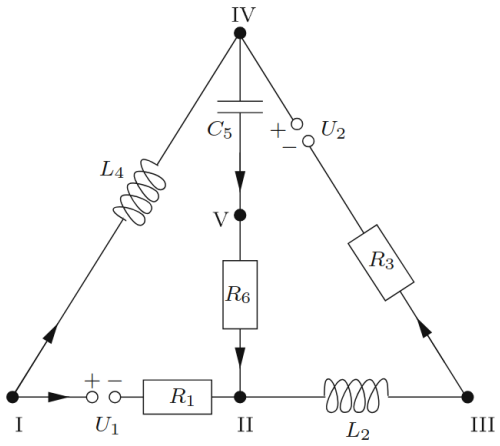
Sheet 2

Due: Wednesday 28.05.2025, 14:00,
Per email at *eric.trebuchon@math.uni-freiburg.de*
Please write your programm in **Octave** or **Python**

Please hand in as pairs of students

Exercise 2: (8 Points)

Solve the following circuit numerically by using complex impedances. The values are given by: $R_1 = R_3 = R_6 = 1\,\Omega$, $L_2 = L_4 = 0,01\,H$, $C_5 = 0,02\,F$, $\omega = 50/s$ and $U_1 = 10\,V$, $U_2 = 5\,V$.



Exercise 3: (*Nonlinear Circuit Analysis with Diodes*) (4+2+4 Points)

The circuit is as shown in the figure on the next page (the ground potential is indicated as $0\,V$ using the ground symbol). The diodes follow the Shockley equation:

$$I = I_S\left(e^{\frac{V_D}{V_T}} - 1\right)$$

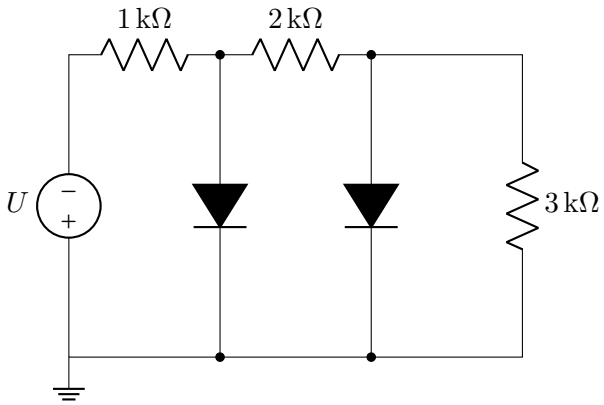
where:

- I is the diode current,
- V_D is the voltage across the diode,
- $I_S = 10^{-12}\,A$ is the reverse saturation current,
- $V_T = 26\,mV$ is the thermal voltage.

(i) For different values of the voltage source U, compute the potentials at the nodes using the Newton-Raphson method.

(ii) Verify Kirchhoff's laws for the circuit.

(iii) You should observe that for moderate source voltages, the voltage drop across each silicon diode is approximately $0.7\,V$—this is the typical forward voltage of a silicon diode.


1 kΩ
2 kΩ
U
3 kΩ