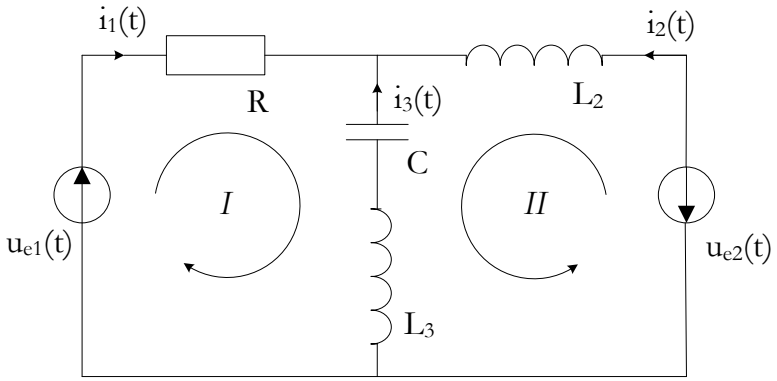
RLC Series Circuit

Example 3.4.1. For the circuit below, using KL, write the system of equations for currents calculation.



Example 3.4.1.

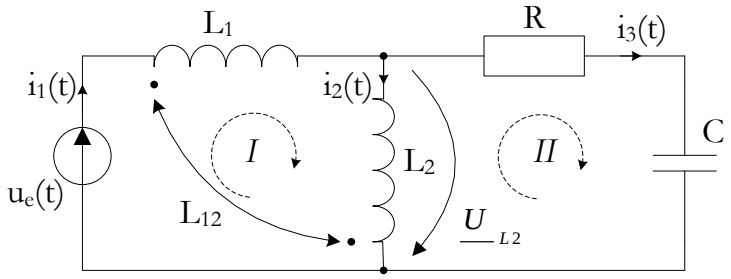
Solution:

The circuit has two nodes and three branches. According to the reference direction of the branch currents and reference directions of the independent loops like in the figure above, the three equations system is:

$$\begin{cases} i_1 + i_2 + i_3 = 0 \\ i_1 \cdot R - \dfrac{1}{C}\displaystyle\int i_3\, dt - L_3 \dfrac{di_3}{dt} = u_{e1} \\ L_2 \dfrac{di_2}{dt} - \dfrac{1}{C}\displaystyle\int i_3\, dt - L_3 \dfrac{di_3}{dt} = -u_{e2} \end{cases}$$

The three equations system should be solved for the currents i_1, i_2, i_3. The system is a nonlinear system, we have derivates and integrals, and more, each unknown current has to be determined by two components: the rms value (or the amplitude) and the phase angle. For the system solving there are necessary enough time and mathematical skills. We have to find an easier way for the calculation of the sinusoidal currents.

Example 3.4.2. For the circuit below, using KL, write the system of equations for currents calculation. Write the expression for the voltage on the inductance L_2.



Example 3.4.2.

Solution:

The circuit has two nodes and three branches. According to the reference direction of the branch currents and reference directions of the independent loops like in the figure above, the three equations system is:

$$\begin{cases} i_1 = i_2 + i_3 \\ L_1\dfrac{di_1}{dt} - L_{12}\dfrac{di_2}{dt} + L_2\dfrac{di_2}{dt} - L_{12}\dfrac{di_1}{dt} = u_e \\ i_3R_3 + \dfrac{1}{C}\int i_3\,dt - \left(L_2\dfrac{di_2}{dt} - L_{12}\dfrac{di_1}{dt}\right) = 0 \end{cases}$$

The voltage on the inductance L_2 is: $u_{L2} = L_2\frac{di_2}{dt} - L_{12}\frac{di_1}{dt}$.