Electric Networks: Computer Aided Analysis and Simulation
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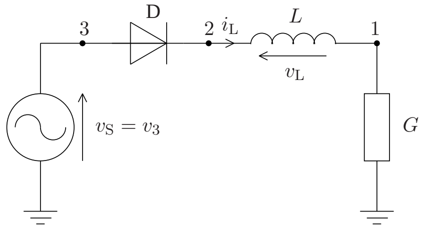
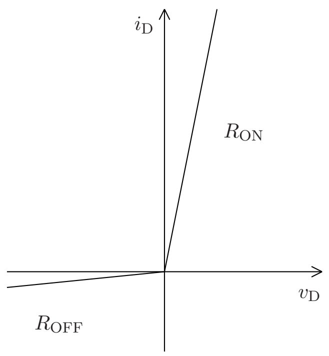
Problem Sheet 6 December 2020

Given is the circuit below with the following parameters: $v_\mathrm{S} = 230\,\mathrm{kV}\cos(2\pi\,60\,\mathrm{Hz}\,t)$, $L = 1\,\mathrm{mH}$, $G = 0.2\,\mathrm{S}$.



The diode is modeled as follows with $R_\mathrm{ON} = 10^{-3}\,\Omega$ and $R_\mathrm{OFF} = 10^{6}\,\Omega$.



V = I*R

R = V / I

a) **6 points** Create a model for the diode and add it to the simulator you wrote for Problem Sheet 5. Model and simulate the above circuit and display the diode current. Use a time step size of $50\,\mu$s and simulate during a time span of $(2/60)\,$s, i. e. during two full periods. Since the trapezoidal method is used, the simulation results are expected to be heavily distorted. Discuss the simulation results.

b) **6 points** Use in your simulator the backward-Euler instead of the trapezoidal method for the modeling of the inductor. Simulate the above circuit and display the diode current again. Discuss the simulation results.

c) **4 points** For the simulation in b), use successively larger time step sizes and discuss its influence. Of interest is here notably the transition of the between different status values of the diode.

Backward - Euler

$$\frac{x(k) - x(k-1)}{\tau} = h(e(k)), \quad x(0) = x_0 .$$