11.5 MATLAB Laboratory Experiment on Circuits

Consider the electrical circuit presented in Figure 11.18. Assume that all resistors in the circuit are $10\,\mathrm{k}\Omega$, the inductors $1\,\mathrm{mH}$, and the capacitors $20\,\mu\mathrm{F}$. Assume that the circuit has been under the constant voltage input $v_s = E = 6\,\mathrm{V}$ for a long period of time.

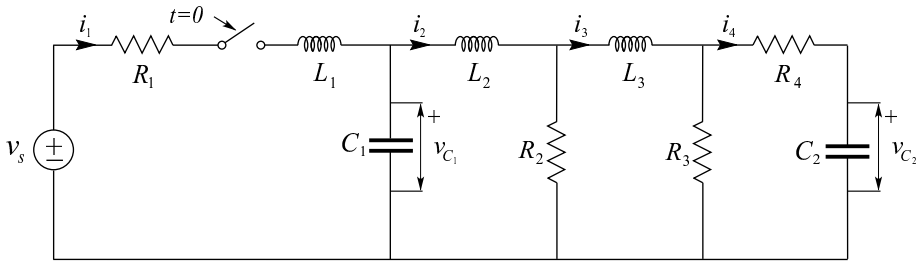

FIGURE 11.18: A complex electrical circuit

Part 1. Use the resistive circuit presented in Figure 11.19 and the corresponding formulas to find the currents through the inductors and the voltages on the capacitors. The values obtained will represent the initial conditions for the problem defined in Part 2.

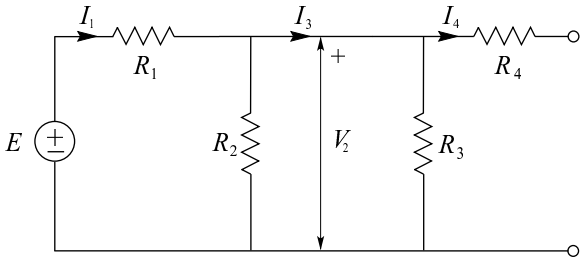

FIGURE 11.19: Simplified electrical circuit that determines consistent initial conditions for electrical circuit in Figure 11.18

Part 2. Assume that the input voltage source is changed to the new value $v_s = E = 12\,\mathrm{V}$. Using state space analysis, form the matrices **A** and **B** and the vector of initial conditions. Use MATLAB to find the currents through the inductors and voltages on the capacitors as functions of time. Observe that such state space variables settle down at steady state to some constant values. Plot all state space variables during the initial time interval until they reach their steady state values. Check the steady state values obtained via MATLAB, using the electrical circuit given in Figure 11.19 and the corresponding formulas. The current and voltage steady state values obtained will serve as the initial conditions in Part 3.

Part 3. Assume that this electrical circuit is exposed to the input voltage $v_s(t) = r(t) - r(t-1)$, where $r(t)$ stands for the ramp signal and the time is measured in seconds. Using MATLAB, find and plot the currents through the inductors and the voltages on the capacitors during the time interval of $2\,\mathrm{s}$.