
ECE 4960: Computational and Software Engineering
Spring 2017

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Programming Assignment 5

0. Objective

The goal of this project was to use the previously written “Mini-SPICE” program in assignment 4, and evolve it to extract the frequency of an NFET cross-coupled oscillator. Before simulating the NFET oscillator however, a simple RLC circuit with a pre-charged capacitor was simulated

1. RLC Circuit

With values of: $R = 0.005 \Omega$, $L = 1 \mu\text{H}$ and $C = 1 \mu\text{F}$, and the capacitor initially charged to **1 V**, figure 1.1 displays the voltage curve obtained when measuring voltage across the capacitor.

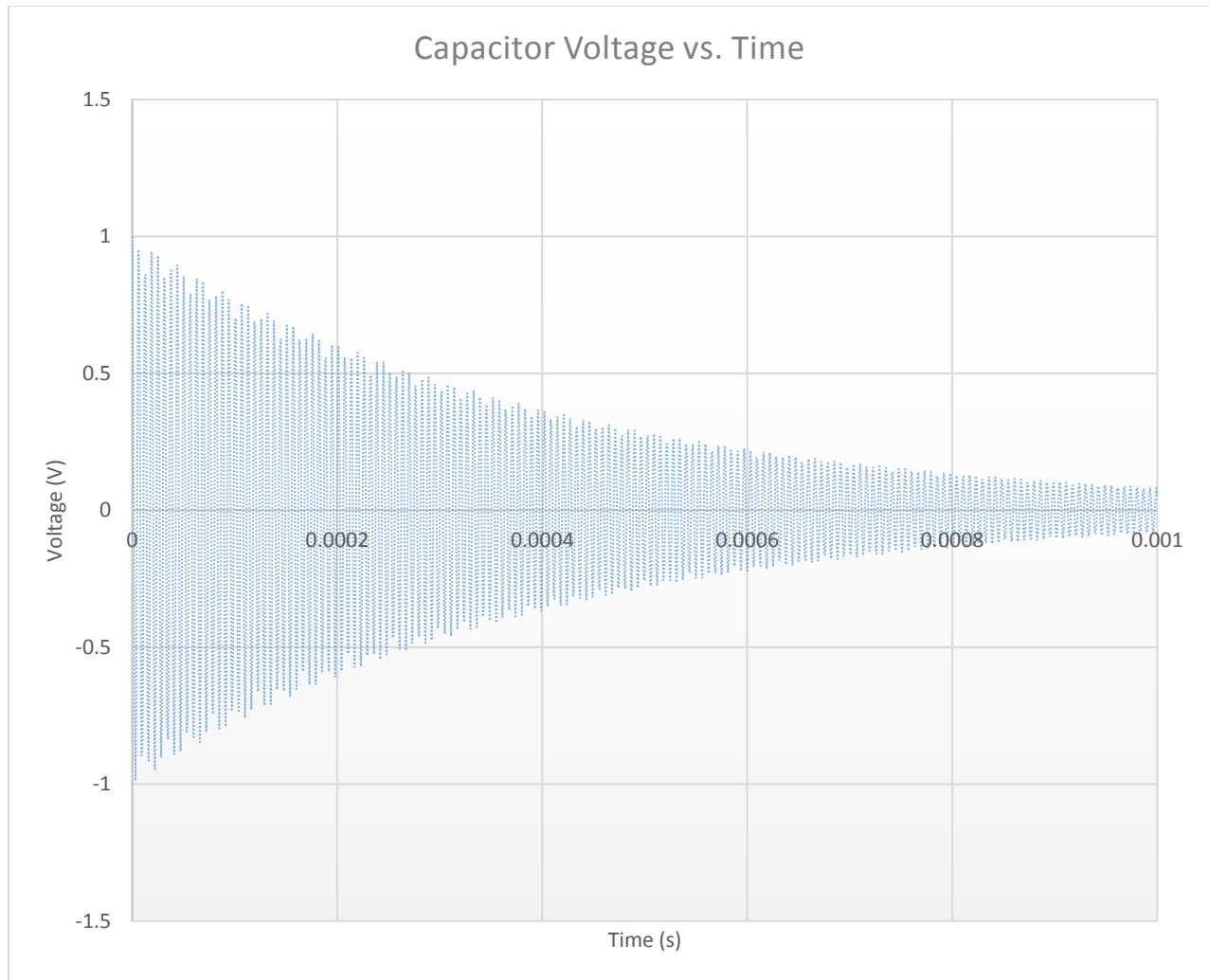


Figure 1.1: Voltage vs. Time curve of an RLC Circuit as simulated by the program

2. NFET Oscillator Circuit

Figure 2.1 shows the Oscillator circuit that was simulated. The circuit differs from the originally proposed circuit in that the bottom rail of the oscillator is not pulled to **ground**, instead of being driven by a Norton source. This was done to simplify the derivation of equations; With a Norton source present the voltage at the bottom node became significantly problematic to find. The equation resulting from applying the Kirchhoff Current Law at the node connecting the sources of the NFET was computationally too complex to solve for the value of the voltage at that node in closed form. The simulated circuit however seems to serve the purpose of the project well.

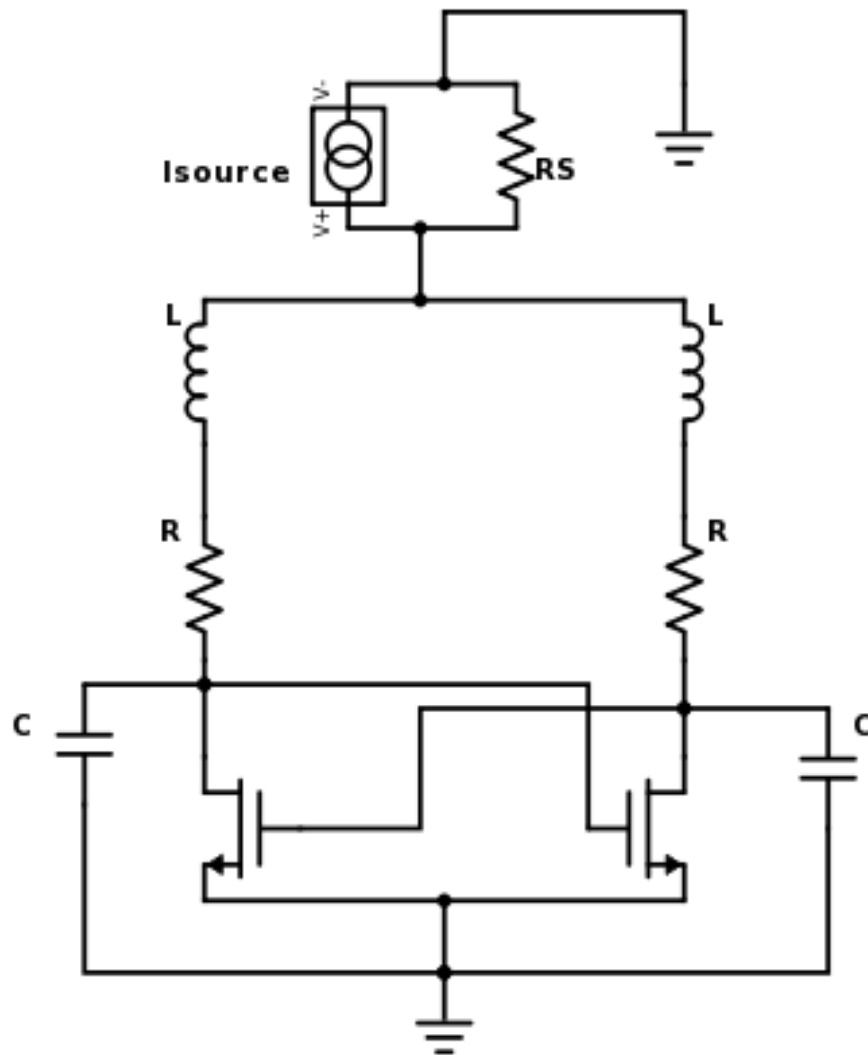


Figure 2.1: NFET cross-coupled oscillator circuit

With values of: $R = 0.01 \Omega$, $L = 10 \mu\text{H}$ and $C = 10 \text{ nF}$, and the left NFET drain node charged to **10 V**, figure 2.2 shows the voltage curves obtained at the gates of the NFET.

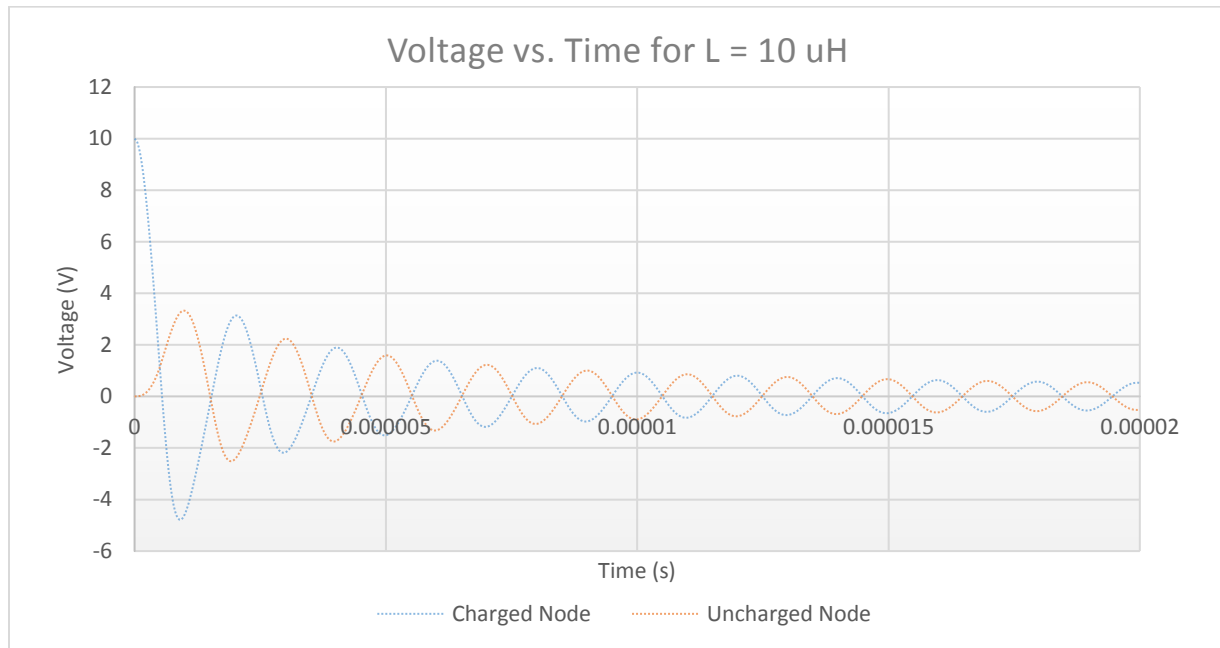


Figure 3.2: Voltage vs. Time curve of an NFET oscillator as simulated by the program

Figure 2.3 shows the voltage curve for constant R and C values as described above, but with varying values of L .

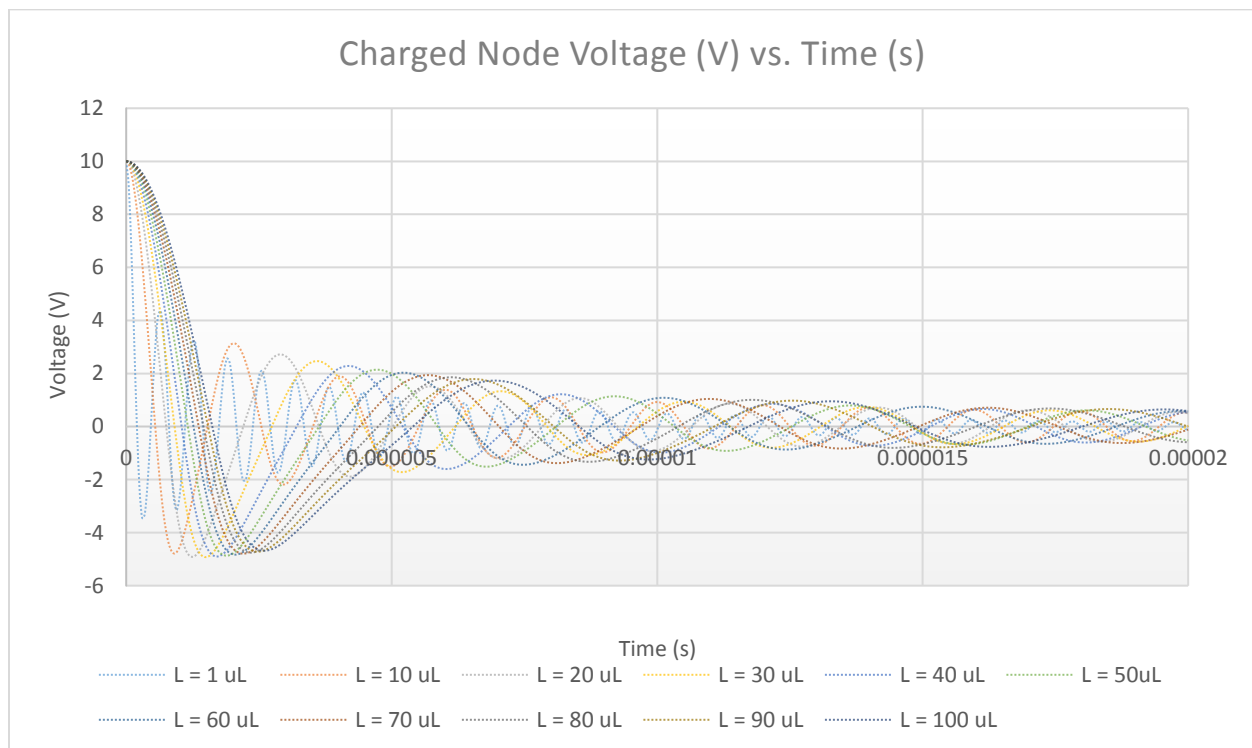


Figure 4: Voltage vs. Time curves of an NFET oscillator for various values of L , as simulated by the program

The data obtained from the simulation of the circuit with varying L values was used to obtain the circuits Frequency dependence on the inductance value, L, of the Inductor.

