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1 Introduction

In signal processing, impulse functions are indispensable tools, offering profound insights into the dynamic behaviors of systems. In this lab we derived the impulse response of a circuit, and visualized it using Python, and compare it to our lab values obtained through an oscilloscope.

2 Theory

Given the circuit in Fig. 1

To obtain the impulse function for the this circuit I converted the circuit to the s domain. Then using node analysis to analyze the circuit yields

$$\frac{y(t) - f(t)}{R} + sCy(t) + \frac{y(t)}{sL} = 0 \tag{1}$$

Solving this equation and changing all s to D yields

$$(D^2 + \frac{D}{RC} + \frac{1}{LC})y(t) = \frac{D}{RC}f(t) \tag{2}$$

Plugging in the given values, solving the differential equation, and creating the impulse response function yields

$$h(t) = 30303.0303 \cdot e^{-15151.52t}\left(-0.08737\sin(173417.02t) + \cos(173417.02t)\right)u(t) \tag{3}$$

3 Results

Comparing the two plots in Fig. 2 we can see that the analytical and lab values are very close to one another. The amplitude of the lab plot is slightly lower than the amplitude of the analytical plot. The lab plot also has a small phase shift when compared to the analytical plot.

4 Discussion and Conclusions

We can see that the two plots in Fig. 2 do not completely agree with each other. This is due to our circuit components having different values than the theoretical values our analytical solution implemented. These discrepancies are due to the tolerance error in each component.

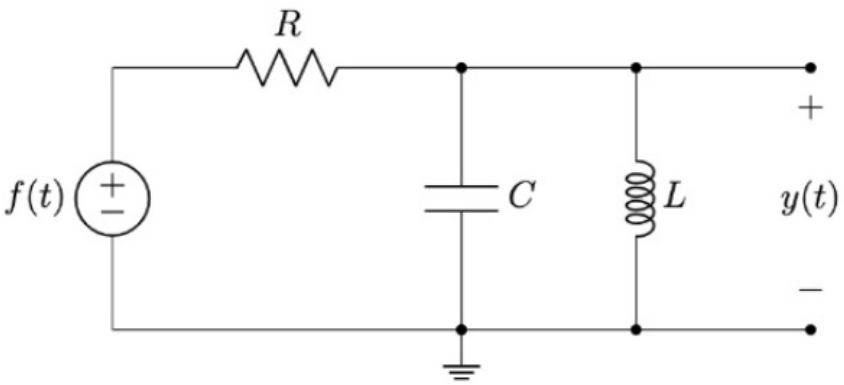

Figure 1: This is the circuit we were given to analyze.

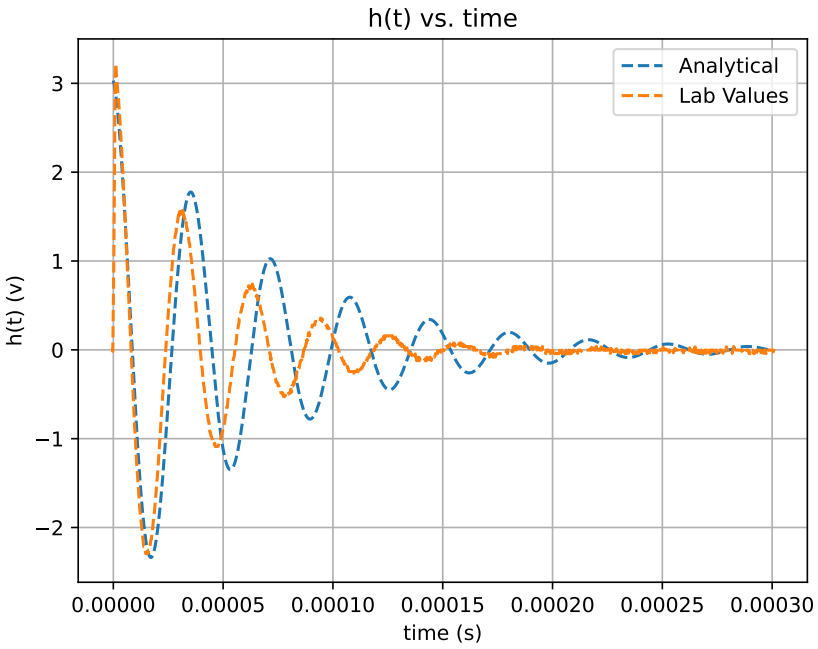

Figure 2: This is the plot generated from python using both an analytical solution and the data we recorded on the oscilloscope.