

Circuit Theory and Electronics Fundamentals

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Example Laboratory Report

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1 Introduction

The objective of this laboratory assignment is to study a circuit containing a sinusoidal voltage source V_I connected to a resistor R and a capacitor C in series. The circuit can be seen in Figure ??.

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In Section ??, a theoretical analysis of the circuit is presented. In Section ??, the circuit is analysed by simulation, and the results are compared to the theoretical results obtained in Section ?. The conclusions of this study are outlined in Section ?.

2 Theoretical Analysis

In this section, the circuit shown in Figure ?? is analysed theoretically, in terms of its time and frequency responses.

3 Time response

The circuit consists of a single V-R-C loop where a current $i(t)$ circulates. The voltage source $v_I(t)$ drives its input, and the output voltage $v_O(t)$ is taken from the capacitor terminals. Applying

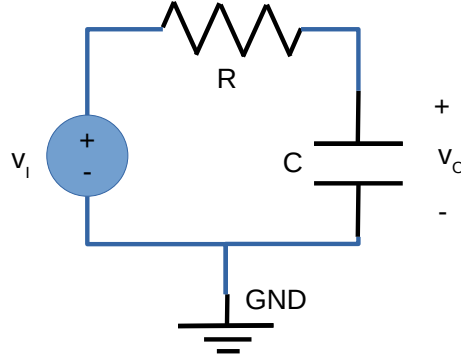


Figure 1: Voltage driven serial RC circuit.

the Kirchhoff Voltage Law (KVL), a single equation for the single loop in the circuit can be written as

$$Ri(t) + v_O(t) = v_I(t). \quad (1)$$

Because v_O is the voltage between capacitor C's plates, it is related to the current i by

$$i(t) = C \frac{dv_O}{dt}. \quad (2)$$

Hence, Equation (??) can be rewritten as

$$RC \frac{dv_O}{dt} + v_O(t) = v_I. \quad (3)$$

Equation (??) is a linear differential equation whose solution is a superposition of a natural solution v_{On} and a forced solution v_{Of} :

$$v_O(t) = v_{On}(t) + v_{Of}(t). \quad (4)$$

As learned in the theory classes the natural solution is of the form

$$v_{On}(t) = Ae^{-\frac{t}{RC}}, \quad (5)$$

where A is an integration constant.

The forced solution is of the form given in Equation (??) and is illustrated in Figure ??.

$$V_{Of}(t) = |\bar{V}_{Of}| \cos(\omega t + \angle \bar{V}_{Of}), \quad (6)$$

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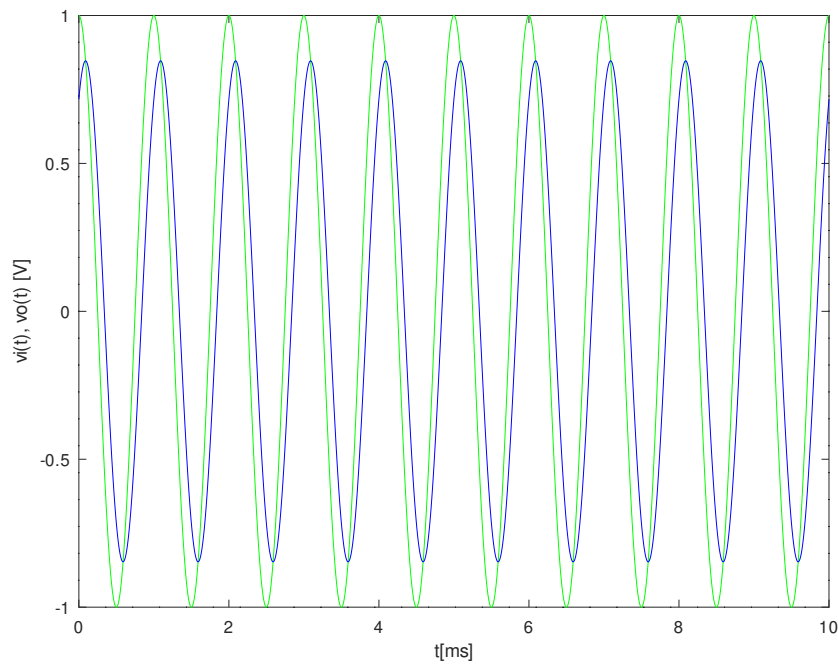


Figure 2: Forced sinusoidal response.

4 Frequency response

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