TÉCNICO LISBOA

Circuit Theory and Electronics Fundamentals

Integrated Masters in Aerospace Engennering, Técnico, University of Lisbon

Laboratory Report 1- Group 28

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1 Introduction

The aim of this laboratory work regarding the topics studied in the first three weeks of the course was to analyse a circuit constituted of an independent voltage source, an independent voltage source, a voltage controlled dependent current source, a current controlled dependent voltage source and seven resistors, as shown in the Figure 1 below. . For this, a theorical analysis was made using both node and mesh methods, whose results will be discussed in section one. To validate these results, a simulation was conducted, as will apeear in section 2.

The forementioned analysis was divided into a theoretical one, presented in section 2.In order to be able to validate the results obtained, a simulation was also conducted, as shown in Section **??**. The results were then compared (Section **??**), and the conclusions of the group summarized in Section **??**.

2 Theoretical Analysis

In this section, a theoretical analysis of the circuit was conducted. Two approaches were chosen: the mesh and the node methods.

2.1 Node Method

The aim of using this method to analyse the circuit is to determine every node voltage. To do so, a reference node(with voltage =0V) was chosen. Then, seven independent equations were

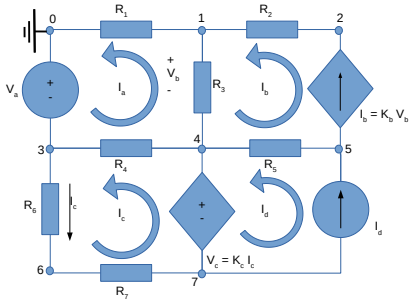

Figure 1: Voltage driven serial circuit.

written in orther to find the remaining unknown node voltage values. The equations were then put in the form of the matriz shown below. Octave math tools were used to solve the seven equations.

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ G1 & G1-G2-G3 & G2 & 0 & G3 & 0 & 0 & 0 \\ 0 & G2+Kb & -G2 & 0 & -Kb & 0 & 0 & 0 \\ 1 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 0 & G1 & 0 & -G4-G6 & G4 & 0 & G6 & 0 \\ 0 & -Kb & 0 & 0 & G5+Kb & -G5 & 0 & 0 \\ 0 & 0 & 0 & G6 & 0 & 0 & -G6-G7 & G7 \\ 0 & 0 & 0 & -KcG6 & -1 & 0 & Kc*G6 & -1 \end{bmatrix} \begin{bmatrix} V0 \\ V1 \\ V2 \\ V3 \\ V4 \\ V5 \\ V6 \\ V7 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ Va \\ 0 \\ -Id \\ 0 \\ 0 \end{bmatrix}]$$

2.2 Mesh Method

The mesh analysis was the chosen method to determine the currents IA, IB and IC. This was achieved by examining the loop formed by R1, R3, R4 and Va and the loop constituted by R4, R6, R7 and Vc, in which the circulating currents are IA and IC, respectively. The third independent equation was obtained equaling IB to Kb*Vb. The equations were then rearrenged in a matrix form as shown below. Octave math tools were used to solve the three equations.

$$\text{A=} \begin{bmatrix} R1+R3+R4 & -R3 & -R4 \\ -R4 & 0 & -Kc+R4+R6+R7 \\ -Kb*R3 & Kb*R3-1 & 0 \end{bmatrix} * \begin{bmatrix} IA \\ IB \\ IC \end{bmatrix} = \begin{bmatrix} -Va \\ Vc \\ 0 \end{bmatrix}$$