



TÉCNICO
LISBOA

Circuit Theory and Electronics Fundamentals

Masters of Aerospace Engineer, Técnico, University of Lisbon

Laboratory Report

Group 37

Afonso Magalhães, nº95765
Fábio Monteiro, nº95786
Leonardo Encarnação, nº95816

March 25, 2021

Contents

1	Introduction	3
2	Theoretical Analysis	3
2.1	Nodal analysis	3
2.2	Mesh analysis	4
3	Simulation Analysis	4
4	Conclusion	4

1 Introduction

The objective of this laboratory assignment is to study a circuit containing dependent and independent of voltage and current sources alongside various resistors. To do so we've obtained the current in the various meshes and the voltage in all the nodes.

In Section 2, a theoretical analysis of the circuit is presented. In Section 3, the circuit is analysed by simulation, and the results are compared to the theoretical results obtained in Section 2. The conclusions of this study are outlined in Section 4.

The following table 1 displays the info that was already given to us:

Initial info	
R1	1.013609e+00 kOhm
R2	2.016578e+00 kOhm
R3	3.006816e+00 kOhm
R4	4.049229e+00 kOhm
R5	3.053925e+00 kOhm
R6	2.092502e+00 kOhm
R7	1.022320e+00 kOhm
Id	1.029587e+00 mA
Kb	7.213324e+00 mA/V
Kc	8.321035e+00 mA/V

Table 1: Table ...

2 Theoretical Analysis

In this section, the circuit shown in Figure ?? is analysed theoretically, in terms of its current and voltage. In analyzing a circuit using Kirchhoff's circuit laws, one can either do nodal analysis using Kirchhoff's current law (KCL) or mesh analysis using Kirchhoff's voltage law (KVL). In the subsections bellow we explain how the two methods ... in solving the circuit.

IMPRIME ISTO

IMPRIME ISTO

2.1 Nodal analysis

The nodal analysis or the branch current method is a method of determining the voltage (potential difference) between "nodes" (points where elements or branches connect) in an electrical circuit in terms of the branch currents. Nodal analysis writes an equation at each electrical node, requiring that the branch currents incident at a node must sum to zero. Since there are 8 nodes in total in this circuit we must have 8 equations in order to find all the 8 voltages.

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

The following table displays the various solutions to the :

BAMUS	
V1	8.194795e+00 V
V2	7.917828e+00 V
V3	7.340169e+00 V
V4	2.978754e+00 V
V5	7.957540e+00 V
V6	1.197664e+01 V
V7	9.776608e-01 V
V8	0.000000e+00 V

Table 2: Table ...

o q da cada um teoricamente

2.2 Mesh analysis

Mesh analysis is a method that is used to solve circuits for the currents at any place in the electrical circuit.

This analysis makes use of Kirchhoff's voltage law to arrive at a set of equations guaranteed to be solvable if the circuit has a solution.

In this case, we use four equations in order to find the four circulation currents, since we have four elementar meshes in this circuit.

$$\begin{pmatrix} R1 + R3 + R4 & R3 & R4 & 0 \\ Kb * R3 & Kb * R3 - 1 & 0 & 0 \\ R4 & 0 & R4 + R6 + R7 - Kc & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} Ia \\ Ib \\ Ic \\ Id \end{pmatrix} = \begin{pmatrix} Va \\ 0 \\ 0 \\ Id \end{pmatrix}$$

The following table is the info that was already given to us:

BAMUS	
Ia	2.732478e-01 mA
Ib	-2.864551e-01 mA
Ic	9.563162e-01 mA
Id	1.029587e+00 mA

Table 3: Table ...

o que da cada um teoricamente

3 Simulation Analysis

4 Conclusion

In this laboratory assignment the objective of analysing the circuit specified in the introduction has been achieved. All analyses have been performed both theoretically using the Octave maths tool and by circuit simulation using the Ngspice tool. The simulation results matched the theoretical results precisely. The reason for this perfect match is the fact that this is a straightforward circuit containing only linear components, so the theoretical and simulation models cannot differ. For more complex components, the theoretical and simulation models could differ but this is not the case in this work.