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Laboratory 1: Circuit Analysis Methods

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Circuit Theory and Electronics Fundamentals

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Contents

1 Introduction

The laboratory assignment presented has of its purpose the study of a circuit structured in four elementary meshes, through which exist seven resistors R_i, a voltage source V_a, a current controlled voltage source V_c, a current source I_d and a voltage controlled current source I_b. The circuit can be seen in Figure-1.

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Throughout the report it is presented a theoretical analysis, a simulation of the circuit and its analysis and a comparison of results.

In Section 2, the are applied both mesh and nods methods, to do a theoretical analysis of the circuit, using the Octave maths tool. In Section 3, it is executed an analysis of the circuit using the Ngspice tool to simulate it. Lastly, in Section 4, it is performed a comparison between the results from both the theoretical analysis and the simulation, from Section 2 and Section 3, respectively.

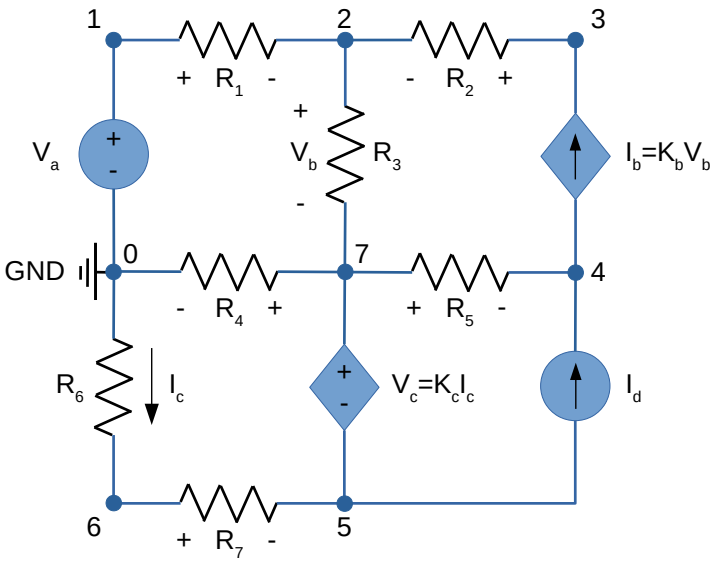

Figure 1: Circuit.

2 Theoretical Analysis

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

Name	Value [A or V]
I_b	-2.263725e-04
I_d	1.011815e-03
I_{R1}	2.161226e-04
I_{R2}	-2.263725e-04
I_{R3}	-1.024993e-05
I_{R4}	1.194589e-03
I_{R5}	-1.238187e-03
I_{R6}	9.784660e-04
I_{R7}	9.784660e-04
V_1	5.125627
V_2	4.903891
V_3	4.446215
V_4	8.768409
V_5	-2.982745
V_6	-1.975719
V_7	4.934963

Table 1: Operating point. A variable preceded by @ is of type *current* and expressed in Ampere; other variables are of type *voltage* and expressed in Volt.

3 Simulation Analysis

3.1 Operating Point Analysis

Table 2 shows the simulated operating point results for the circuit under analysis.

Name	Value [A or V]
gib[i]	-2.26373e-04
id[current]	1.011815e-03
r1[i]	2.161226e-04
r2[i]	-2.26373e-04
r3[i]	-1.02499e-05
r4[i]	1.194589e-03
r5[i]	-1.23819e-03
r6[i]	9.784660e-04
r7[i]	9.784660e-04
v(1)	5.125627e+00
v(2)	4.903891e+00
v(3)	4.446215e+00
v(4)	8.768409e+00
v(5)	-2.98275e+00
v(6)	-1.97572e+00
v(7)	4.934963e+00
v(8)	-1.97572e+00

Table 2: Operating point. A variable followed by [i] or [current] is of type *current* and expressed in Ampere; other variables are of type *voltage* and expressed in Volt.

As we can see, the simulation results are similar to the ones we obtained in the section 2, concerning both the numerical values and the directions. Note that, unlike the table 1, in the simulation results we present an extra voltage at node 8, V_8, that is a ”dummy” node used to compute the dependent voltage source.

4 Conclusion

After the theoretical analysis and the simulation, it can be concluded that the objective of the work, the study of the circuit presented in Figure-1, has been accomplished.

There were performed a theoretical analysis, applying both mesh and nodes methods, using the Octave maths tool, and a circuit simulation, using the Ngspice tool, with which it is clear a seamless match of the theoretical and the simulation results. The achievement of the equality in results comes from the components of the circuit, which are all linear and, therefore, both models have to present the same results.