

## Laboratory 1: Circuit Analysis Methods

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Circuit Theory and Electronics Fundamentals

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### 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, using both mesh and nodes methods, in Section 2; an analysis of the circuit, in Section 3; a comparison of the results from both sections Section 2 and Section 3, in Section 2; and conclusions of the study, in Section 4.

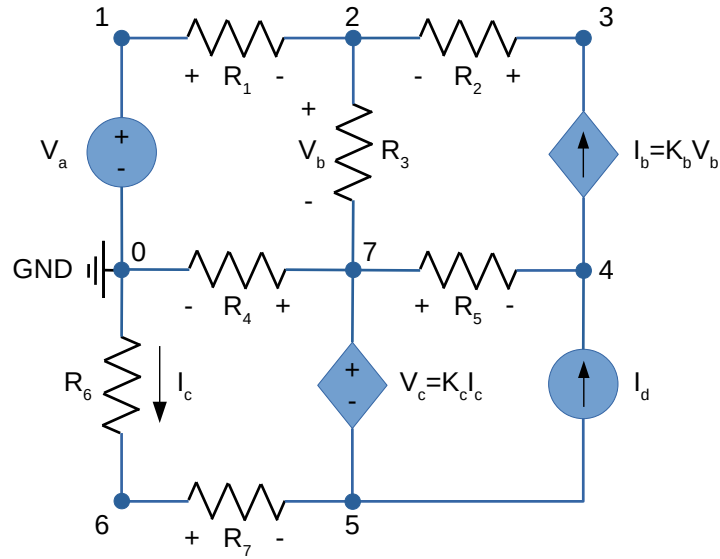


Figure 1: Voltage driven serial RC circuit.

## 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. This was expected since Ngspice uses the same methods we applied to solve this particular circuit. 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

In this laboratory assignment the objective of analysing an RC circuit has been achieved. Static, time and frequency 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.