TÉCNICO LISBOA

Circuit Theory and Electronics Fundamentals

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T1 Laboratory Report

Group 34

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Contents

1 Introduction

The objective of this laboratory assignment is to study a circuit containing both independent and linearly dependent voltage and current sources. The circuit also contains 7 resistors, totaling 11 components conected both in series and in paralel. The circuit has 7 nodes and 4 meshes. The circuit can be seen in Figure 1. The values of the resistors, the independent sources and the and the constants for the dependent sources are presented in figure ....********************. These values were obtained using the Python script provided by the professor responsable for the laboratory assigment and using 95815 as the seed

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.

2 Theoretical Analysis

In this section, the circuit shown in Figure 1 is analysed theoretically, using two methods: the mesh analysis and the nodal anaylis.

The circuit consists of a 6 resistors

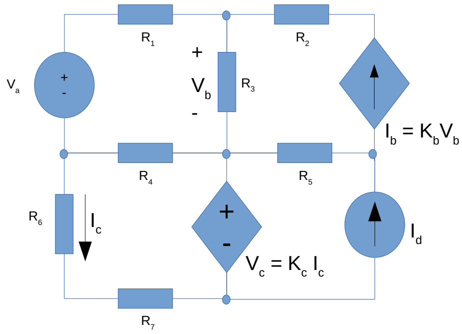

Figure 1: Circuit in study

MESH EQUATIONS

$$R_1 I_{SE} + R_3(I_{SE} + I_{SD}) + R_4(I_{SE} + I_{IE}) = Va$$
$$R_6 I_{IE} + R_7 I_{IE} + R_4(I_{IE} + I_{SE}) = K_c I_{IE}$$
$$I_{SD} = K_b R_3(I_{SE} + I_{SD})$$
$$I_{ID} = Id$$

NODAL EQUATIONS

$$V_0 = 0$$
$$V_8 = V_7$$
$$(V_1 - V_2)/R_1 + (V_0 - V_8)/R_6 + (V_0 - V_4)/R_4 = 0$$
$$(V_2 - V_4)/R_3 + (V_2 - V_3)/R_2 + (V_2 - V_1)/R_1 = 0$$
$$-K_b(V_2 - V_4) + (V_3 - V_2)/R_2 = 0$$
$$(V_5 - V_4)/R_5 + K_b(V_2 - V_4) - Id = 0$$
$$(V_7 - V_6)/R_7 + (V_7 - V_0)/R_6 = 0$$
$$V_1 - V_0 = V_a$$
$$V_4 - V_6 = K_c(V_0 - V_7)/R_6$$

3 Simulation Analysis

3.1 Operating Point Analysis

Table 2 shows the simulated operating point results for the circuit under analysis. Compared to the theoretical analysis results, one notices the following differences: describe and explain the differences.

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.

Name	Mesh method	Node method
@Gb	-0.291567	-0.291567
@id	1.018915	1.018915
@r1	-0.278049	-0.278049
@r2	-0.291567	-0.291567
@r3	-0.013518	-0.013518
@r4	1.226887	1.226887
@r5	1.310482	1.310482
@r6	-0.948838	-0.948838
@r7	-0.948838	-0.948838
V1	5.243596	5.243596
V2	4.952740	4.952740
V3	4.367469	4.367469
V4	4.994112	4.994112
V5	9.086122	9.086122
V6	-2.926767	-2.926767
V7	-1.963402	-1.963402
V8	-1.963402	-1.963402

Table 1: A variable preceded by @ is of type *current* and expressed in milliampere (mA); other variables are of type *voltage* and expressed in Volt (V).

Name	Value [A or V]
@gb[i]	-2.91567e-01
@id[current]	1.018915e+00
@r1[i]	-2.78049e-01
@r2[i]	-2.91567e-01
@r3[i]	-1.35178e-02
@r4[i]	1.226887e+00
@r5[i]	1.310482e+00
@r6[i]	-9.48838e-01
@r7[i]	-9.48838e-01
v(1)	5.243596e+00
v(2)	4.952740e+00
v(3)	4.367469e+00
v(4)	4.994112e+00
v(5)	9.086122e+00
v(6)	-2.92677e+00
v(7)	-1.96340e+00
v(8)	-1.96340e+00

Table 2: Operating point. A variable preceded by @ is of type *current* and expressed in Ampere; other variables are of type *voltage* and expressed in Volt.