



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

2 Introduction

The aim of this laboratory assignment is to analyse a RC circuit, which contains a sinusoidal voltage source v_s and a capacitor C . The other components present in this four mesh circuit are 7 resistors (from R_1 to R_7) and a linearly dependent current I_b and voltage V_d sources.

The voltage controlled current source depends on the constant K_d and the current controlled voltage source has a linear dependence on the constant K_b .

The voltage source varies in time as it follows:

$$v_s(t) = V_s u(-t) + \sin(2\pi ft)u(t) \quad (1)$$

where

$$u(t) = e \begin{cases} 0 & t < 0 \\ 1 & t \geq 0 \end{cases} \quad (2)$$

The data generated automatically by the Python script is given in the table below.

Name	Value
R1	1.041113e+03
R2	2.099452e+03
R3	3.131091e+03
R4	4.119470e+03
R5	3.115588e+03
R6	2.047994e+03
R7	1.027544e+03
Vs	5.068716e+00
C	1.041275e-06
Kb	7.287471e-03
Kd	8.115684e+03

Table 1: Initial data generated by Python script. All variables are expressed in Ohms, V, F, S or A.

The nodes (from V_1 to V_8) are displayed as it shows in Figure ???. The fourth node is considered to be the ground one.

The circuit is analysed by simulations using the program Ngspice. An operating poin analysis is used to analyse the circuit when $t \downarrow 0$ and also to determine the time constant. Both natural and forced solutions are computed with a transiet analysis. Frequency analysis are also made. All the Ngspices simulations are compared with the theoretical results.

In Section 1, for $t < 0$, the voltage and the currents in all branches were determined with the node method. In Section 2, both the equivalent resistor R_{eq} , seen from the capacitor terminals, and the nodes voltage were computed. The natural solution is determined in the interval $[0, 20]$ ms in Section 3, followed in the next section with the computation of the forced solution. These solutions were superimposed. Phasors were converted to real time functions. In Section 6, the voltage (v_c , V_s and V_6) responses due to variation of frequencies were computed. Theoretical analysis are made in all of the sections.

The conclusions of this study are outlined in the final section.

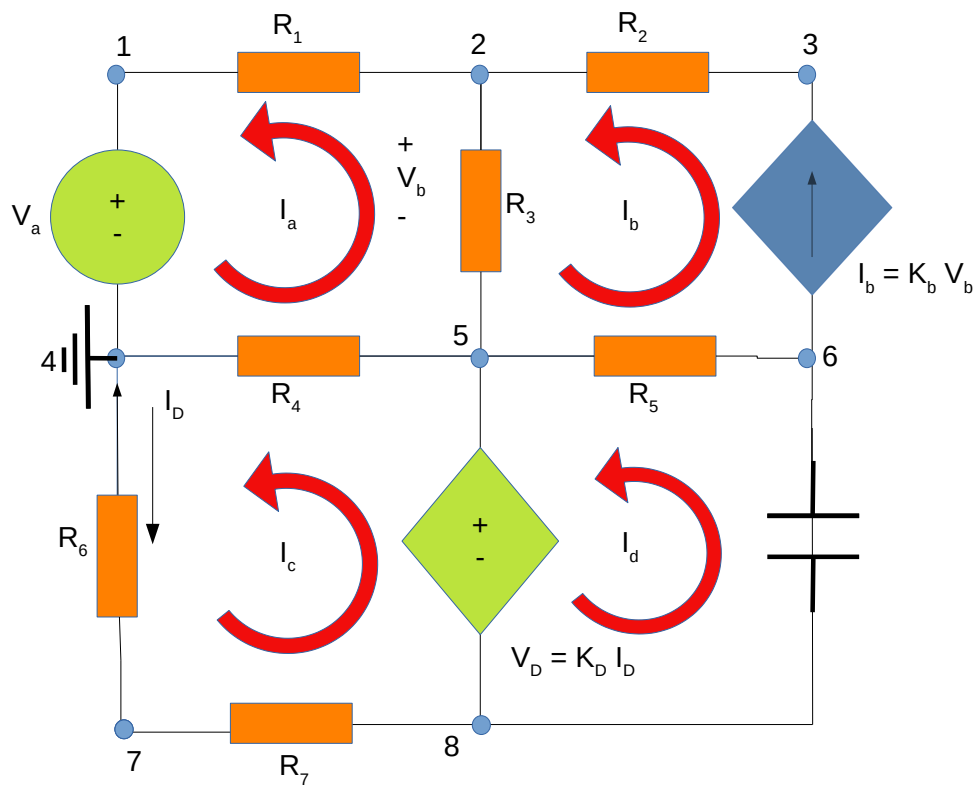


Figure 1: Circuit analysed.

3 Conclusion

It was agreed by the members of the group that the main goal of the task proposed was achieved. As presented, both theoretical and simulation results (obtained using Octave tools and ngpsice simulator, respectively) matched, reaching total accuracy. Despite the initial belief that the considerable number of components of the circuit could cause some disparity in the results, such did not happen. This proves not only the efficiency of both mesh and node methods to analyse the circuit, as well as the simulator used.