Circuit Theory and Electronics Fundamentals

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Laboratory Assignment - T2

Group nº59

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Contents

1 Introduction

The objective of this laboratory assignment is to study a circuit containing:

- seven resistors (R_1-R_7)

- one voltage source (V_s)
- one capacitor (C)
- one voltage-controlled current source (I_b)
- one current-controlled voltage source (V_d)

Circuit T2 is presented in Figure 1. All components, including nodes ($N1$-$N8$) and ground(GND or 0), are identified with their respective names. Note that I_b is also refered to as G_1 and V_d as H_1 (explanation can be found in Subsection **??**).

In Section **??**, a theoretical analysis (using two distinct methods) of the circuit is presented. In Section 2 , the circuit is analysed by simulation, and the results are compared to the theoretical results obtained in Section **??**. The conclusions of this study are outlined in Section **??**.

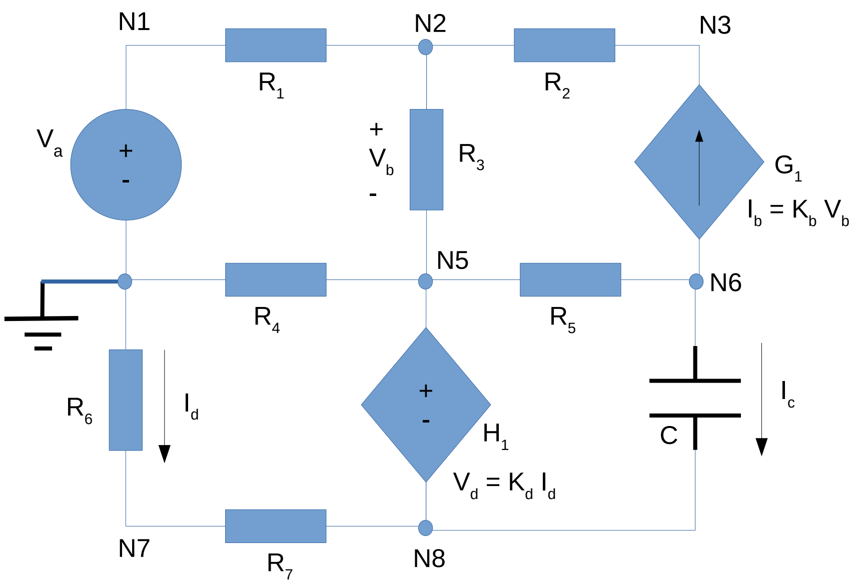

Figure 1: Circuit T2

For this laboratory assignment, the values considered for all the varibles can be found on Table 1. They were obtained through a Python script that generates random values.

2 Simulation Analysis

In this section, Circuit T2 is reproduced with the help of Ngspice. Each section corresponds to each task. Ngspice is a simulator for eletronic circuits that can output a variety of results. This emulator computes the voltages in every node, as well as the potential difference between two given nodes. Apart from that, the group made use of the command *.options savecurrents* which also enables the output of the currents that pass through all branches.

Name	Value
$R1$	1.00359089673
$R2$	2.04298963569
$R3$	3.02503141993
$R4$	4.05647775356
$R5$	3.07781188185
$R6$	2.01277040929
$R7$	1.01993304256
V_s	5.11402517827
C	1.03896393154
K_b	7.23768458527
K_d	8.33526265782

Table 1: Values provided by the Python sript. Units for the values: V, mA, kOhm, mS and uF

With the limitation that Ngspice only provides the current in the components and not through the nodes, an aditional voltage source ($Vaux$) was added so that the current in R_6 (I_d) is known. This source (not displayed in Figure **??**) has a voltage of 0V and it was implemented between R_6 and R_7. Therefore an aditional node had to be added (node $N7.$).

As previously stated, I_b is refered to as G_1. This is because, in Ngspice, a voltage-controlled current source is identified with capital 'g' (G). In the case of V_c, all current-controlled voltage source are identified with H.

2.1 Task 1)

In this subsection, the circuit is simulated when $t < 0$. There is no need for a transient analysis because $v_s(t)$=V_s (according to the data given), therefore all values are constante in time.

Table 2 shows the simulated operating point results for Circuit T1.

The three last entries in Table 2 provides the potential diference between important branches: V_b = $v(n5, n2)$; V_d = $v(n5, n8)$; the voltage drop in C is equal to $v(n6, n8)$

2.2 Task 2)

In this subsection, the circuit is simulated when $t = 0$. The capacitor is replaced with a voltage source, with its value being equal to de diference between nodes $n6$ and $n8$, or V_x = $V(n6) - V(n8)$.

Table 3 shows the simulated operating point results for Circuit T1.

Name	Value [A or V]
i(vaux)	9.187367e-04
i(h1)	-9.18737e-04
@g1[i]	-2.95727e-04
@r1[i]	-2.82220e-04
@r2[i]	-2.95727e-04
@r3[i]	1.350709e-05
@r4[i]	-1.20096e-03
@r5[i]	-2.95727e-04
@r6[i]	9.187367e-04
@r7[i]	-9.18737e-04
n1	5.114030e+00
n2	4.830797e+00
n3	4.226630e+00
n5	4.871656e+00
n6	5.781848e+00
n7	-1.84921e+00
n7.	-1.84921e+00
n8	-2.78625e+00
v(n5,n2)	4.085936e-02
v(n5,n8)	7.657909e+00
v(n6,n8)	8.568100e+00

Table 2: Values from Ngspice. Variables identified with a '@' or are of the type $i(...)$ have a corresponding value in Ampere (A). The others are expressed in Volts (V).

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