Theoretical solutions

1-

<table>
<tr>
<td>Figure 1:
$5\ V = V_1 = I_1.R_1$
$5\ V = I_1.\ (1\ k\Omega)$
$I_1 = 5\ mA$</td>
<td>Figure 2:
$5\ V = V_2 + V_3 = I_2.R_1 + I_2.R_2$
$5\ V = I_2.\ (1\ k\Omega) + I_2.\ (10\ k\Omega)$
$5\ V = I_2.\ (11\ k\Omega)$
$I_2 = 0.45\ mA$
$V_2 = 0.45V$
$V_3 = 4.54V$</td>
</tr>
<tr>
<td>Figure 3:
$5V = V_4 = V_5 = I_3.R_1 = I_4.R_2$
$5V = I_3.\ (1\ k\Omega) = I_4.\ (10\ k\Omega)$
$I_3 = 5mA$
$I_4 = 0.5mA$</td>
<td>Figure 4:
$5V = I_5.R_{eq} = I_5.(R_1+R_2/2)$
$5V = I_5.\ (1\ k\Omega + 5\ k\Omega) = I_5.\ (6\ k\Omega)$
$I_5 = 5/6mA = 0.83mA$
$V_6 = I_5.R_1 = (5/6mA).(1\ k\Omega) = 5/6V = 0.83V$
$V_7 = V_8 = 5V - V_6 = 25/6V = 4.17V$
$I_6 = V_7/R_2 = I_7 = V_8/R_2 = (25/6V)\ /\ (10\ k\Omega) = 5/12mA = 0.42mA$</td>
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<td colspan="2">Figure 5:
$25V = I_8.R_{eq} = I_8.[R_1+[(R_3+R_2).\ R_2]/(2R_2+R_3)] = I_8.[\ 1\ k\Omega + 5.7k\Omega] = I_8.[\ 6.7k\Omega]$
$I_8 = 25V\ /\ 6.7\ k\Omega = 3.73\ mA = I_9 + I_{10} = 3.73\ mA$
$V_9 = I_8.R_1 = 3.73\ V$
$(25V - V_9) = V_{11} = V_{10} + V_{12} = 21.27\ V$
$V_{11} = I_9.R_2 = I_9.(\ 10\ k\Omega) = 21.27\ V$
$I_9 = 2.13\ mA$
$I_{10} = I_8 - I_9 = (3.73\ mA) - (\ 2.13\ mA) = 1.6\ mA$
$V_{10} = I_{10}.R_3 = (1.6\ mA).(\ 3.3k\Omega) = 5.28V$
$V_{12} = I_{10}.R_2 = (1.6\ mA).(\ 10k\Omega) = 16\ V$</td>
</tr>
</table>

2-

$I_{11} = i_a + i_b$

$i_a = i_c + i_d$

$i_e = i_b + i_c$

$(5-V_x)/1 = (V_x-V_y)/10 + (V_x-0)/3.3$

$(V_Y-0)/10 = (5-V_y)/10 + (V_x-V_Y)/10$

$V_x = 3.77\ V$

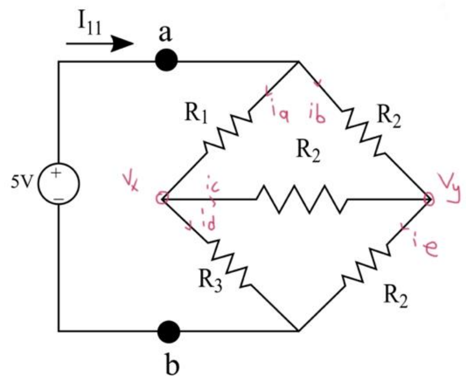
$V_Y = 2.92\ V$

$i_a = 1.23\ mA,\quad i_b = 0.21\ mA,\quad i_c = 0.08\ mA$

$i_d = 1.14\ mA,\quad i_e = 0.29\ mA$

$I_{11} = 1.44\ mA$

$R_{eq} = 5V/I_{11} = 5V/1.44\ mA = 3.47\ k\Omega$



3-

Resistors	Color Codes (10% Tolerance)
22 kΩ	Black-Red-Red-Orange-Silver
3.3 kΩ	Black-Orange-Orange-Red-Silver
12 kΩ	Black-Brown-Red-Orange-Silver
18 kΩ	Black-Brown-Grey-Orange-Silver
1 MΩ	Black-Brown-Black-Green-Silver

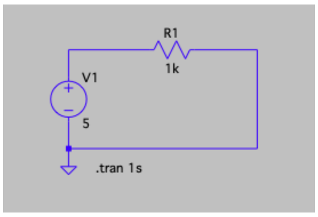
4-

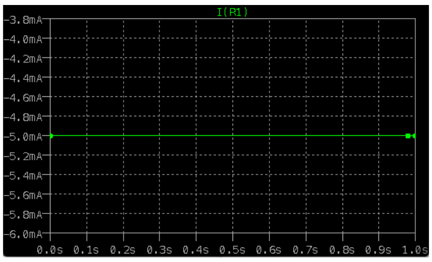
SMD Resistor	Resistance Value	Calculation method
100	10 Ω	$10 \times 10^{0} = 10\ \Omega$
472	4.7 kΩ	$47 \times 10^{2} = 4700\ \Omega = 4.7\ k\Omega$
00R1	0.1Ω	00.1 Ω = 0.1 Ω
0R2	0.2Ω	0.2Ω
1002	10 kΩ	$100 \times 10^{2} = 10000\ \Omega = 10\ k\Omega$

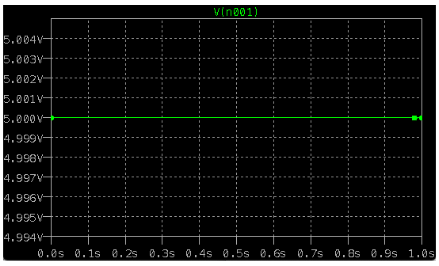
1.4 Experimental Work: Simulation Solutions

1-

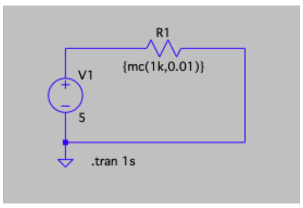
i)

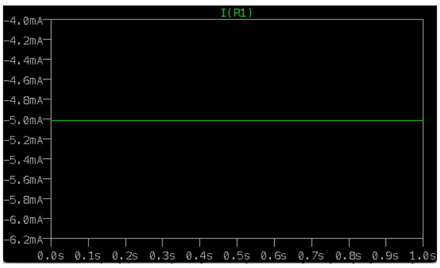


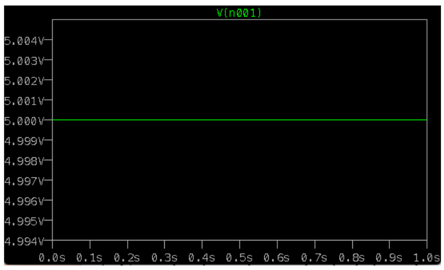


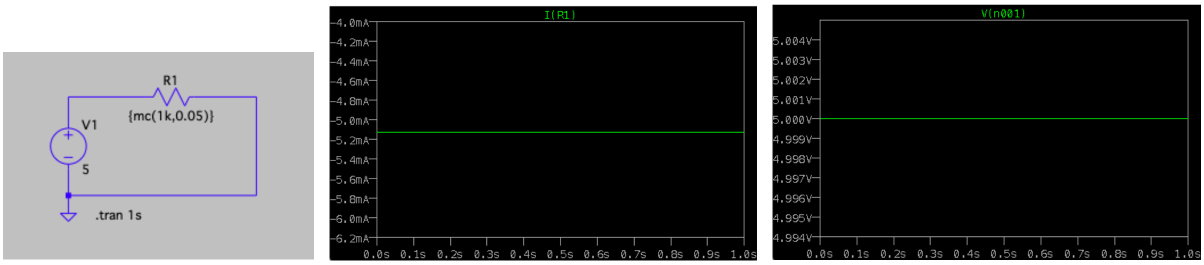


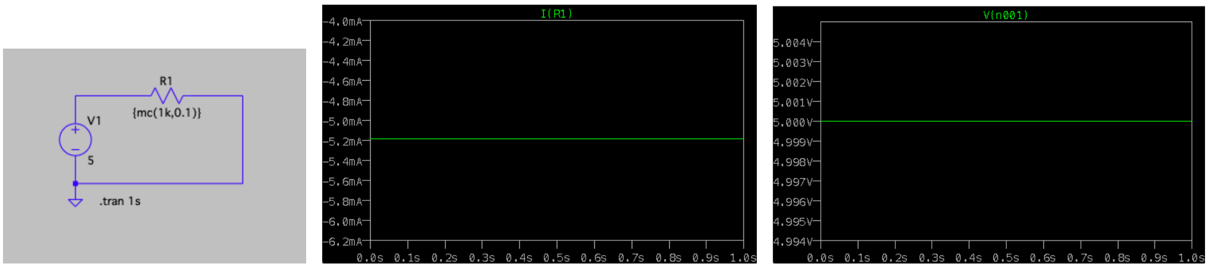
ii)







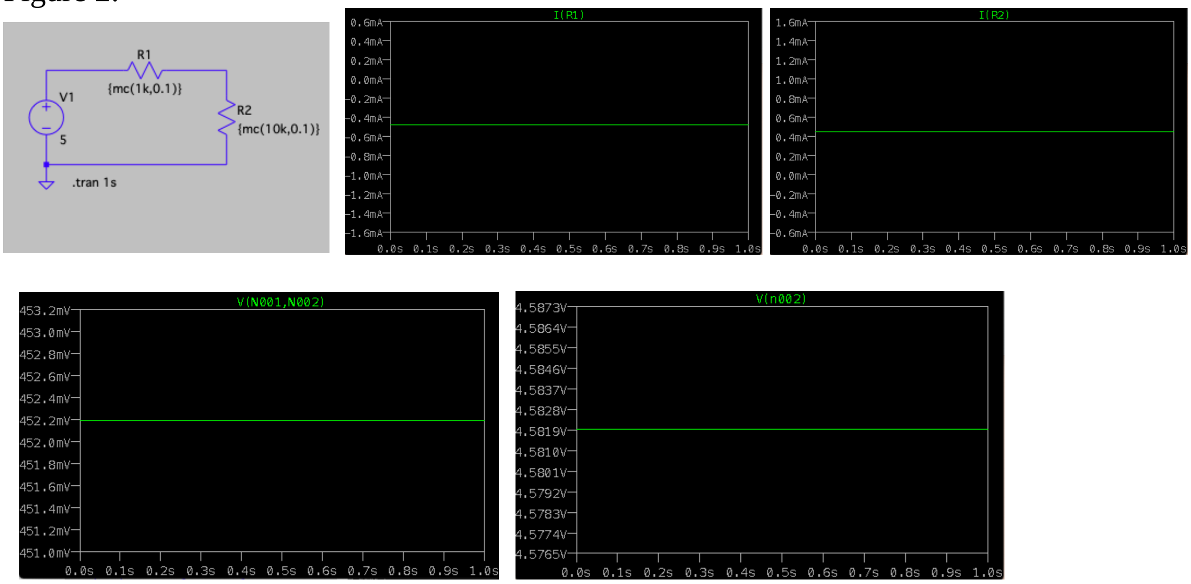




iii) 10% is the worst case among them. As the tolerance percentage increases, the value of the resistance deviates from its value.

2-

Figure 2:



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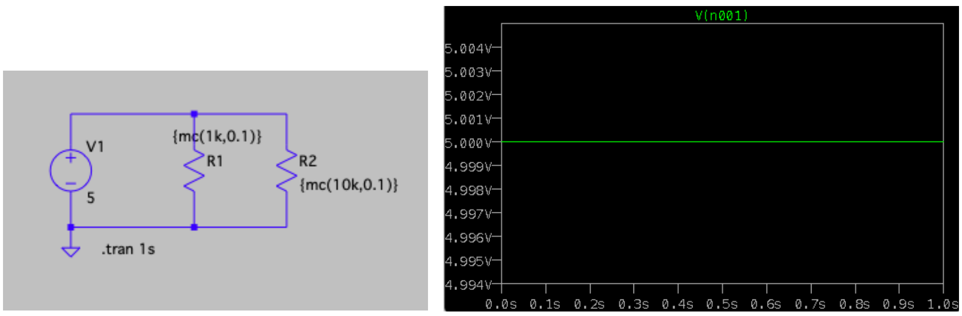


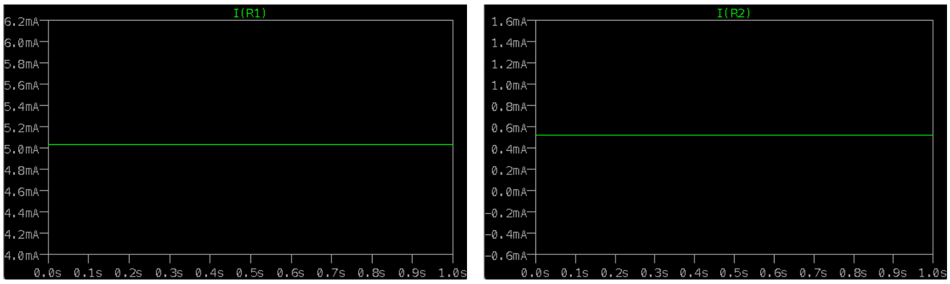


Figure 4:

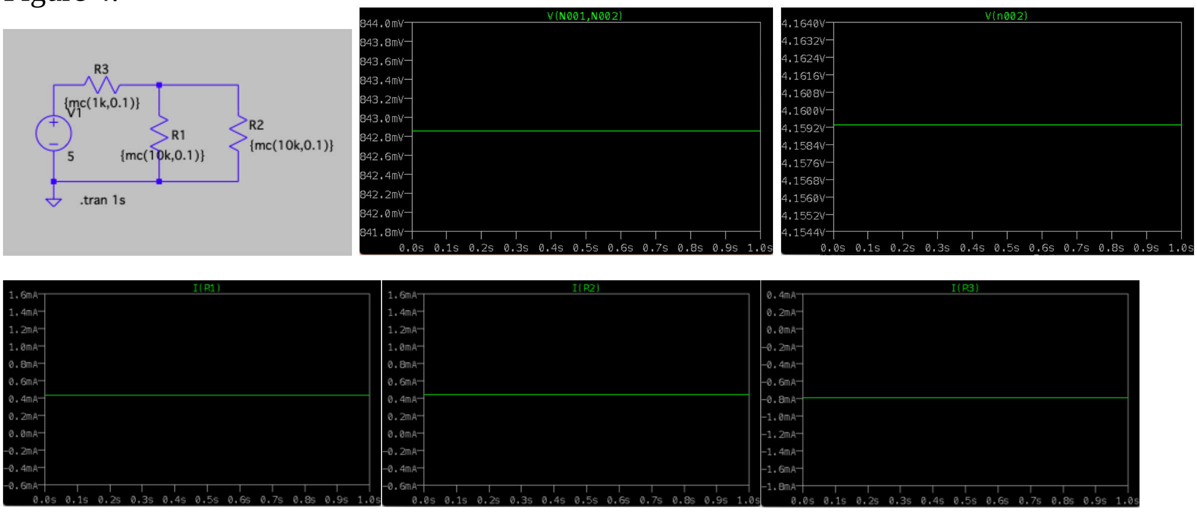
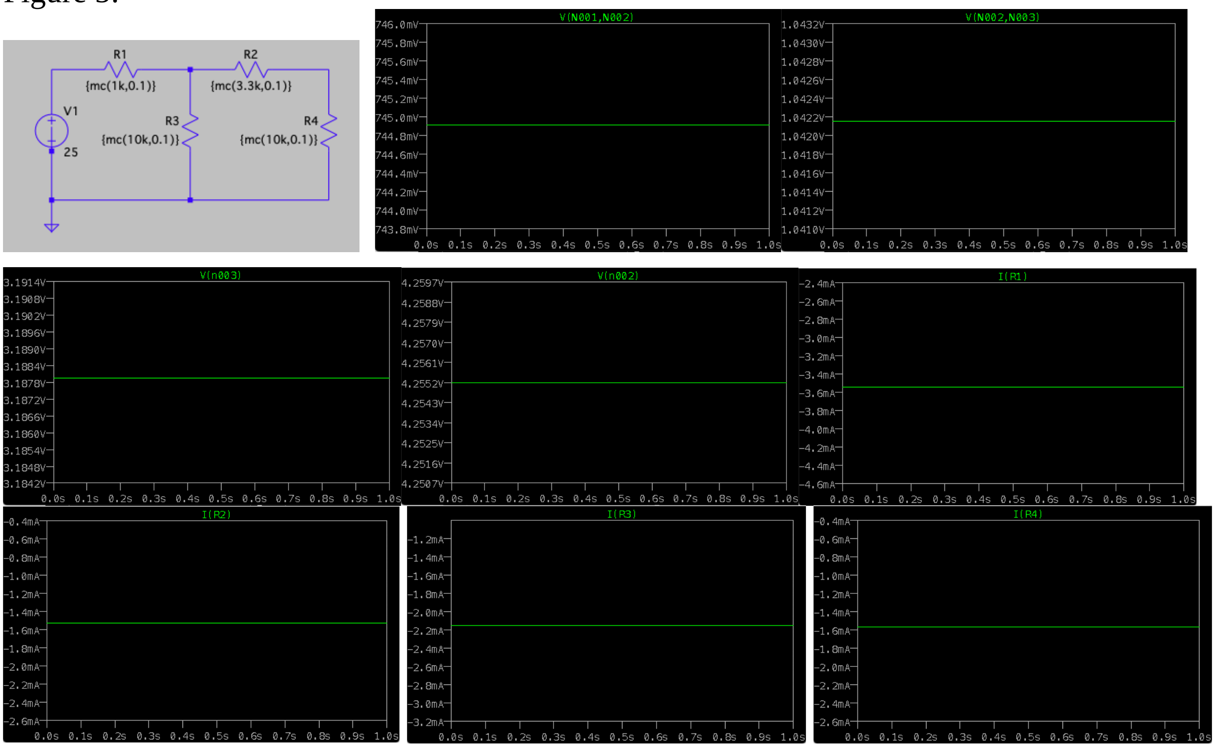
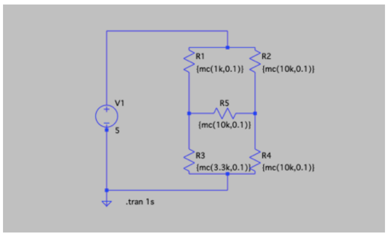


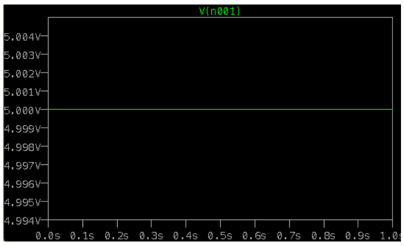
Figure 5:

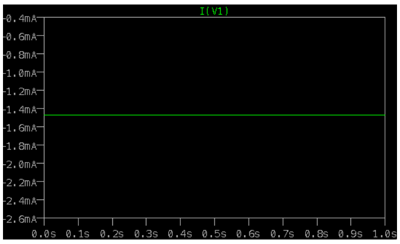


Comparison: My theoretical results and my simulations results are almost same, there is only little differences due to tolerances.

4-







R_{ab}= 5V /1.5mA = 3.33 kΩ

Comparison: My theoretical results and my simulation results are almost same, there is only little differences due to tolerances.

5- If we use ideal resistors, theoretical results and simulation results are same. However, if we add tolerance, simulation results became a little bit different as it is in real life.

EE281 EXPERIMENT 1

REPORT SHEET

Name & Surname : Derya Tınmaz

Date :25.09.2020

Experimental Work: Simulation solutions

	Voltages				Currents	
	Simulation	Calculated			Simulation	Calculated
V_1	5 V	5 V		I_1	5 mA	5.19 mA
V_2	0.45 V	0.41 V		I_2	0.45 mA	0.43 mA
V_3	4.54 V	4.59 V		I_3	5 mA	5.1 mA
V_4	5 V	5 V		I_4	0.5 mA	0.55 mA
V_5	5 V	5V		I_5	0.83 mA	0.81 mA
V_6	0.83 V	0.8 V		I_6	0.42 mA	0.41 mA
V_7	4.17 V	4.2 V		I_7	0.42 mA	0.42 mA
V_8	4.17 V	4.2 V		I_8	3.73 mA	3.55 mA
V_9	3.73 V	4 V		I_9	2.13 mA	2.18 mA
V_{10}	5.28 V	5 V		I_{10}	1.6 mA	1.58 mA
V_{11}	21.27 V	21 V				
V_{12}	16 V	16.3 V				

Comments: My theoretical results and my simulation results are almost same, there is only little differences due to tolerances, as expected.

1. Conclusion:

Q-1: How many measurement terminals of multimeter are used when measuring resistance, current and voltage? What is the importance of the polarity of the measurement terminals?

2 terminals are used, but we connect them in different way to measure different things.
If we measure terminals without considering polarity, the absolute value of the measurement would be true, but sign of the measurement might be false.

Q-2: How to connect the ammeter and voltmeter to the measured element? Parallel or series and how?

The ammeter is connected to the circuit in series. It must be on the wire that we want to measure the current of it.
The voltmeter is connected to the circuit in parallel. Its two terminals must be connected to the interval of the circuit that we want to measure the voltage of it.

Q-3: If I used 1 Ohm instead of 1k Ohm in figure 1 circuit, what happens on the physical circuit?

Resistors have a power limit 250mW. If we used 1 Ohm, the power on the resistor would be 5W, so the resistor would burn.

Q-4: How tolerances distort measurements for circuits containing resistors only? How the situation changes for serial and parallel connections.

Tolerances make little differences on the measurements, both for serial and parallel connections.