SARKAR, Mohul

Experiment Number 2

Series & Parallel Ckts

TUESDAY

March 12

ECE 1101L

Spring 2024

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Lab:

ECE 1101L Experiment 2

SERIES AND PARALLEL CIRCUITS

OBJECTIVES

-The objective of this lab is to measure and calculate voltages and currents in both Series and Parallel Circuits.

MATERIALS REQUIRED BY STUDENT

-11 clip leads

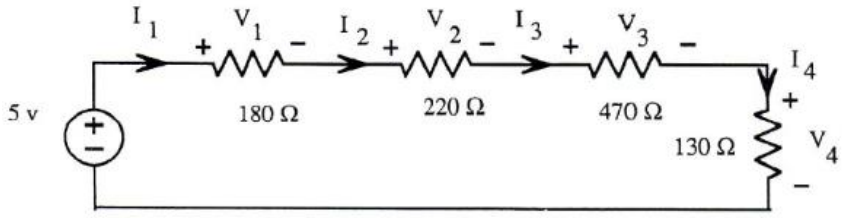
-A breadboard plus jumper wires

-Required Resistors and a 1 kΩ Potentiometers

MATERIALS TO BE SUPPLIED

-Power Cables

Given CKT1:



Per sign convention shown on CKT1						
	Voltage Across Element		Current through Element		Equivalent Resistance	Comments
Resistance [Ω]	Ref Des	Measured Value [V]	Ref Des	Measured Value [mA]	R_{eq} [Ω]	
180	V_1	0.68	I_1	5	1KΩ	
220	V_2	0.90	I_2	5		
470	V_3	2.20	I_3	5		
130	V_4	1.22	I_4	5		
	$V_1 + V_2 + V_3 + V_4 = 0$		$I_1 = I_2 = I_3 = I_4$			

Verify KCL:

$I_1 = I_2 = I_3 = I_4 = 5$ mA

Verify KVL:

$V_1 + V_2 + V_3 + V_4 = 0$

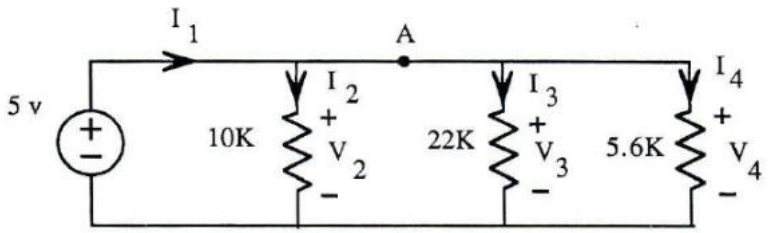
$0.68+0.9+2.2+1.22=5 - 5$

$0=0$

$R_{eq} = 180 + 220 + 470 + 130$

$R_{eq} = 1000\ \Omega$ or $1k\ \Omega$

Given CKT2:



Per sign convention shown on CKT2						
	Voltage Across Element		Current through Element		Equivalent Resistance	Comments
Resistance [Ω]	Ref Des	Measured Value [V]	Ref Des	Measured Value [mA]	R_{eq} [Ω]	
0	V_1	5	I_1	1.6	3.09K	
10K	V_2	5	I_2	0.5		
22K	V_3	5	I_3	0.21		
5.6K	V_4	5	I_4	0.89		
	$V_1 = V_2 = V_3 = V_4$		$-I_1 + I_2 + I_3 + I_4 = 0$			

Verify KCL at Node A:

$-I_1 + I_2 + I_3 + I_4 = 0$

$-1.6+0.5+0.21+0.89=0$

$0=0$

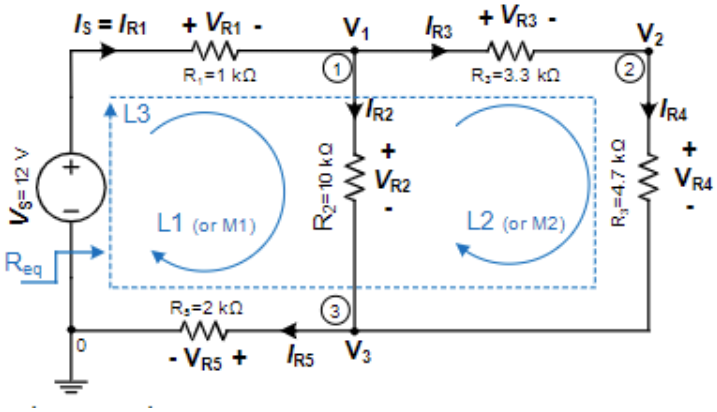
R_{eq} Calculation:

$1/10{,}000 + 1/22{,}000 + 1/5{,}600 = 1/R_{eq}$

$0.324K = 1/R_{eq}$

$R_{eq}=3.09K\ \Omega$

Given CKT3:



Per sign convention shown on CKT2						
	Voltage Across Element		Current through Element		Equivalent Resistance	Comments
Resistance [Ω]	Ref Des	Measured Value [V]	Ref Des	Measured Value [mA]	R_{eq} [Ω]	
1K	V_{R1}	1.6	I_{R1}	1.6	7.44K	
10K	V_{R2}	7.1	I_{R2}	0.7		
3.3K	V_{R3}	2.93	I_{R3}	0.9		
4.7K	V_{R4}	4.23	I_{R4}	0.9		
2K	V_{R5}	3.19	I_{R5}	1.6		
	Loop 1: $V_{R1}+V_{R2}+V_{R5}=0$ Loop 2: $V_{R1}+V_{R3}+V_{R4}+V_{R5}=0$					

Verify KCL Loop 1:

$V/R_1 + V/R_2 + V/R_5 = 0$

$1.6 + 7.1 + 3.19 = \sim 12\ V - 12\ V = 0$

Verify KCL Loop 3:

$V/R_1 + V/R_3 + V/R_4 + V/R_5 = 0$

$1.6 + 2.93 + 4.23 + 3.19 = \sim 12\ V - 12\ V = 0$

$R_{eq1}(R_3+R_4) = 8K\Omega$

$R_{eq2}(R_{eq1}+R_2) = (1/8 + 1/10)^{-1}$

R_{eq2} = 4.44K

$R_{eq(final)}$= 4.44K+1K+2K

$R_{eq(final)}$= 7.44K

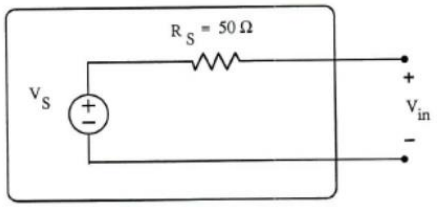
Discussion of Results:

In this lab I focused on parallel and series resistor circuits, I conducted several experiments on various circuits to explore the principles of Kirchhoff's Current Law (KCL) and Kirchhoff's Voltage Law (KVL). My objective was to verify that my measured values from the ohmmeter and voltmeter aligned with the calculated values based on the provided resistor and voltage values. Through experimentation and analysis, my lab results were highly successful. Upon comparing my measured values obtained using the ohmmeter and voltmeter with the calculated values, I found perfect alignment. This validation affirmed my understanding of KCL and KVL but also showed the precision of my experimental techniques. The synchronization between the lecture and practical experimentation helped to illustrate how the KCL and KVL worked practically.

Post Lab:

with 10 volts across the 500 Ω load resistor mistakenly "set" the supply to 10 volts **before** connecting the 500 Ω resistor!!!

a. Then what would the voltage across the 500 Ω load resistor actually be assuming the power supply can be modelled by

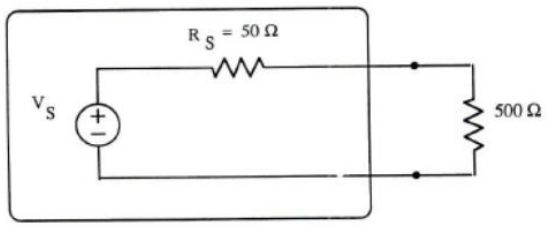


1a.

To be able to find the voltage across a 500 Ω resistor I must use voltage divider. Since there are 10 V being supplied to the circuit, and its given that V_{in} goes over a 500 Ω along with a 50 Ω internal resistance. Using

these values I can derive the equation $V_{in} = V_{out}(500\ \Omega/500\ \Omega + 50\ \Omega)$ where V_{out} is equal to 10 V. The voltage given from this equation is 9.09 V.

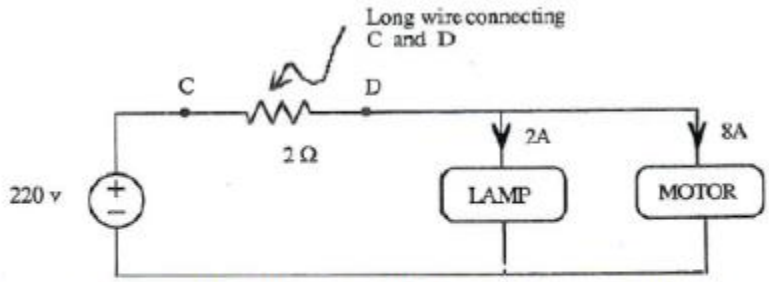
where V_S is an ideal source (no internal resistance) and where $R_S = 50\Omega$ models the real supply's internal resistance – therefore giving us the more or less realistic model



1b. b. What would V_S have to be in the above circuit for V_{in} to be 10 volts

In order to find V_s I will also use voltage divider. Since I have the same values the equation will be $V_s = V_{out}(500\ \Omega/500\ \Omega+50\ \Omega)$. V_{out} will be equal to 10 V and in that case this would be V_s must be equal to 11 V.

2. Given:



where the motor is drawing 8 A and the lamp is drawing 2 A.

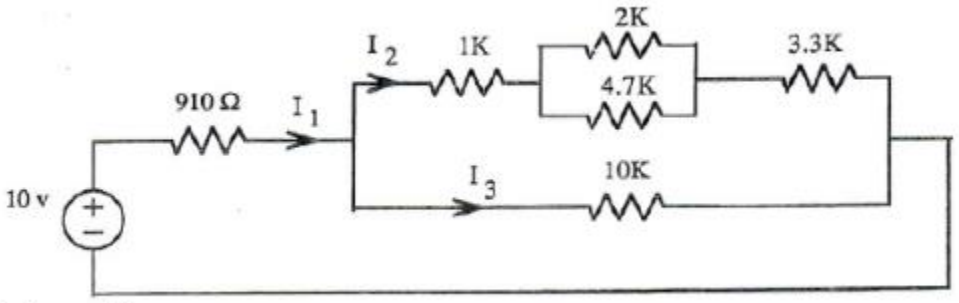
Find:

- The voltage drop across the wire (modeled by the 2 Ω resistor) connecting everything together.
- The voltage across the motor and lamp.

The first step is to find the voltage drop across the wire. I will use ohm's law, the given voltage and given resistors. Using Kirchoff's Current Law I know that there are 2 A traveling into the lamp and 8mA going into the motor meaning there must be 10 A flowing around the circuit. With these given values, I can find V = 10mA * 2 Ω which shows a 20 V drop across that resistor. Since there are 200 V exiting the resistor, and the lamp and motor are in parallel, I can divide by 2 because the lamp and

motor must have the same voltage going across them. So, the voltage going across the lamp and motor is 100 V each respectively.

3. Given:



Find I_1, I_2, and I_3.

R_{eq}(2K+4.7K)= (1/2000+1/4700)^-1= 1.4K

R_{eq}(1K+1.4K+3.3K)= 5.7K

I_1 = 10V/ 0.91K = 10.99 mA

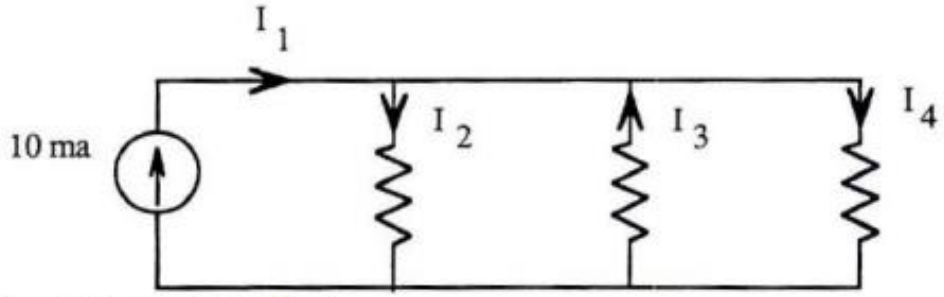
(10 V/ 5.7K) + I_3=0

I_3= 9.24 mA

-10.99+I_2+9.24=0

I_2=1.75 mA

4. Given:



Find I_4, if I_2 = 3 mA and I_3 = -4 mA.

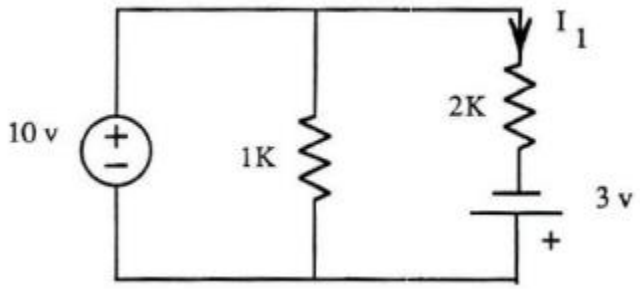
I_1+I_3=I_2+I_4

I_4=I_1-I_2+I_3

I_4=10 mA-4mA-3mA

I_4=3 mA

5. Find I_1 in:



I_1=3V/2K

I_1=1.5 mA