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EGR 24L Introduction of Circuit Analysis Laboratory

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Lab#4
Mesh, Nodal, and Superposition Principle

Introduction:

In this lab we had learned the principle of Mesh Analysis, Nodal Analysis, and Superposition Analysis. All these principles were significant to electrical engineering indeed because each concept is the foundation of understanding the circuit. Mesh analysis is used to determine the current inside the circuit. Nodal analysis help to provide all nodal voltage and respect to ground node. Superposition principle help to solve the circuit that has multiple independent sources. It helps us to narrow down each position on circuit where the source flow reach to each node on the circuit.

We start from doing Mesh analysis by building a circuit and using DMM to measure the resistance of each resistor and measure the voltage from two power supplies as well. After that we compare the experiment data that we recorded to LT spice data to determine whether it accurate or not. Next part we the Nodal Analysis by using LT spice create stimulator drawing of circuit then we determine the theoretical value of all the nodal voltage of circuit. After that we constructed a real circuit on breadboard, record all four nodes value then compared to the LT spice value. Lastly, we move on to Superposition Principle we perform the lab similar from task one and two. We use LT spice create the circuit and determent the value of Va, Vb, Vc and Vd, then compare the value to the physical constructed circuit. Overall, our experimental values were not far off from Theoretical values.

Therefore, in Lab4 we did learn another significant topic which are Mesh Analysis, Nodal Analysis, and Superposition Analysis. All these topics is the core of electrical engineer use to analyze the circuit and determine the current and voltage flow. This lab helps us to open another the opportunity door to explore more fantastic concept behind the circuit.

Procedure:

1. **Mesh Analysis-** We start from using LT spice draw the circuit from the spec sheet that professor provided.

2. Next, we determine current flow from each source value to each node by using simulator DMM that we learned in the class on LT spice record the value then move on next step.

3. Then, we construct the circuit and use real DMM to determine the current Source value flow and record them. Now, we compare theoretical value from LT spice to physical circuit. We found that the value on experimental value is lower and off by a bit. We expect due to each component are also had internal resistance which make the impact to the value that we obtain.

4. **Nodal Analysis-** We follow similar step like first task. We are using LT spice draw the circuit from spec sheet that professor provide. We are using hack DMM to determine four nodal voltage value and record them.

5. Then, we construct the actual real circuit then we use the real DMM to measure each nodal voltage from circuit and record the value. Now, we compare the experimental value to theoretical value from LT spice. We also obtain value which lower than LT spice. We expect due to each component are also had internal resistance which make the impact to the value that we obtain.

6. **Superposition Principle-** We do the something from previous task, we draw the circuit by using LT spice, determined all four nodal voltage values at node Va, Vb, Vc and Vd by follow the step on the spec sheet. We start to measure and record value from V1 alone while deactivate V2 and do V2 alone while deactivate V1. We also record the sum of two partial voltage as well.

7. Then, we construct the real physical circuit using the same concept that we did on the simulator LT spice. We repeat the step of measure and record value from V1 alone while deactivate V2 and do V2 alone while deactivate V1. Next, we record the sum of two partial voltage then we compare all values from LT spice to real circuit. We found our experimental that obtain were lower than LT spice value. We expect due to each component are also had internal resistance which make the impact to the value that we obtain.

Conclusion:

In conclusion in this lab, we had learned another important concept which are Mesh Analysis, Nodal Analysis, and Superposition Analysis. This topic is the help us to understand more fundamental concept of electrical and circuit and relationship of Ohm's law. I found myself understand more the relationship between current flow and current Sources. I believe I will apply this knowledge that I had learn to the future project and job in the future. The concept itself and the help from professor help us to explore deeper concept of electrical.

Appendixes:

Mesh analysis

Mesh current (clockwise)	Theoretical result (μA)	Measured result (μA)
Ia	2.16	2.09
Ib	-0.0014	-1.0 mA

incorrect values

Nodal analysis

Nodal voltage	Theoretical result (V)	Measured result (V)
Va	5	5
Vb	7.159	6.982
Vc	-2.84	-2.10
Vd	1.21	1.17

Superposition analysis

	Theoretical result (V)			Measured result (V)		
Node	V1 alone	V2 alone	V1 & V2	V1 alone	V2 alone	V1 and V2
Va	5	0	5	5	0	5
Vb	0	6.512	6.512	0	6.89	6.89
Vc	0.648	-3.488	-2.84	0.61	-3.21	-2.6
VD	0.1095	1.1008	1.210	0.1002	1.098	1.198
Superposition principle verified. (Yes/No)					Yes	

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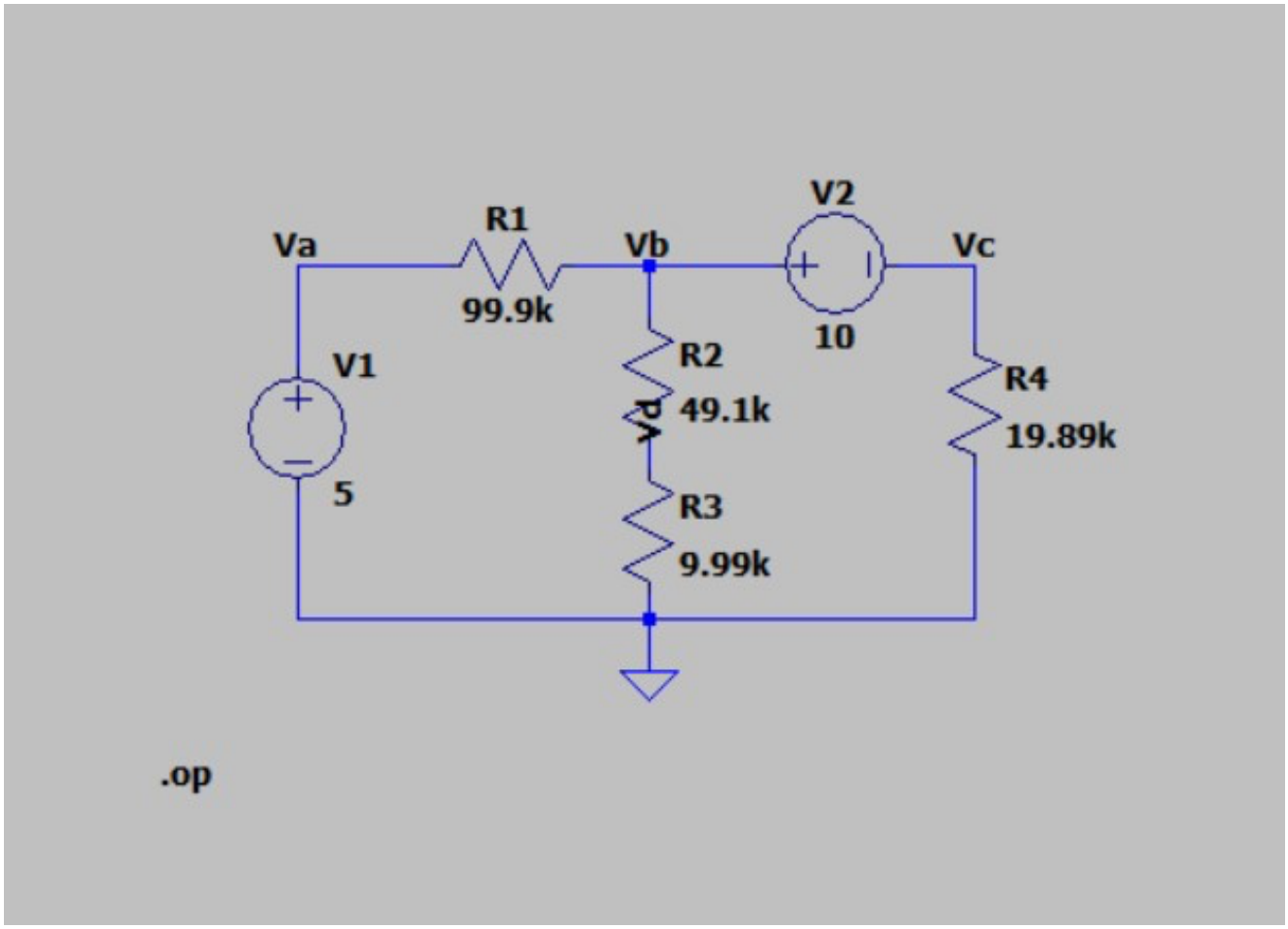
* C:\Users\kmate\Documents\Desk\Fall 2023\Eng24l\
        --- Operating Point ---

V(vc):          -2.8401         voltage
V(vb):          7.1599          voltage
V(vd):          1.21048         voltage
V(va):          5               voltage
```



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I(R4):          -0.00014279     device_current
I(R2):          0.000121169     device_current
I(R3):          0.000121169     device_current
I(R1):          2.16207e-05     device_current
I(V1):          2.16207e-05     device_current
I(V2):          -0.00014279     device_current
```

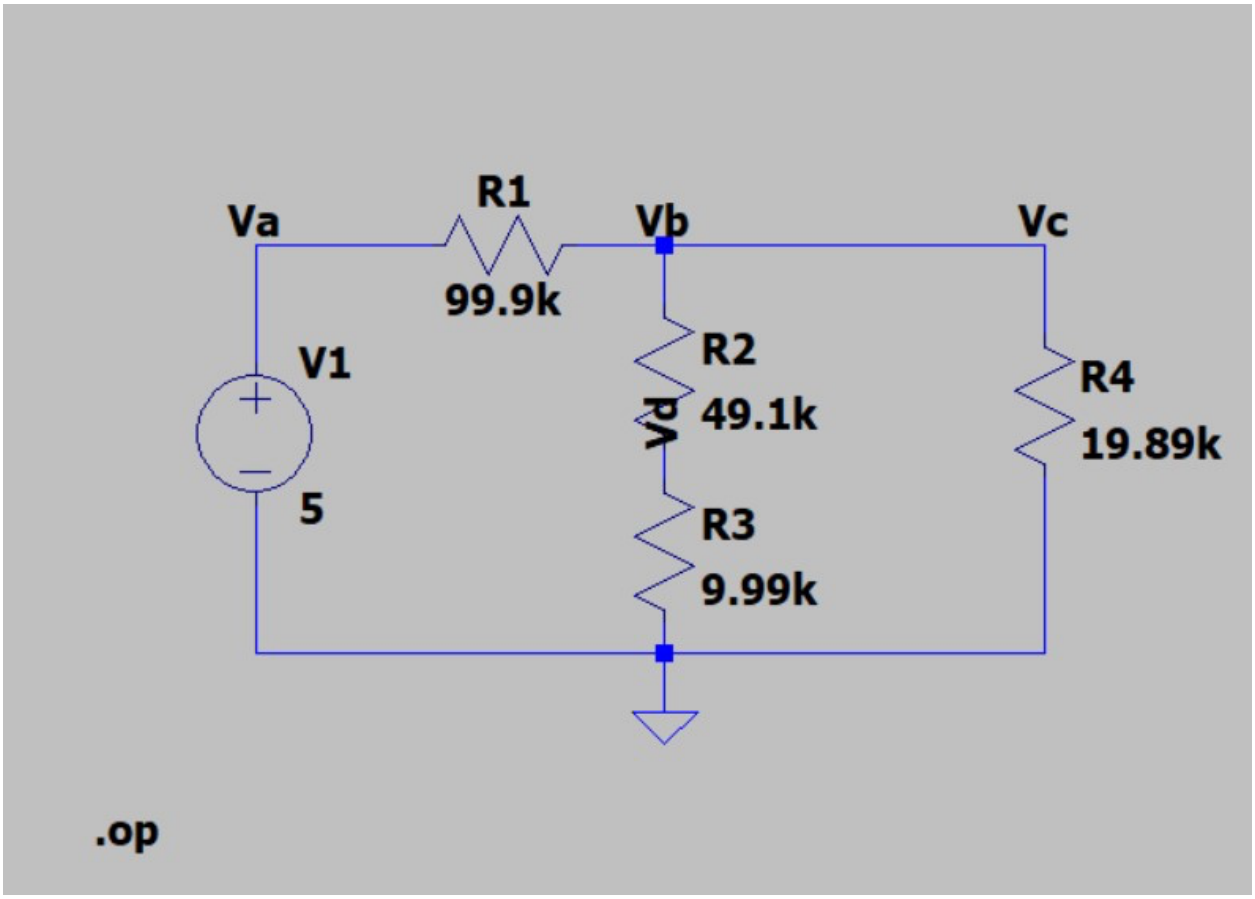

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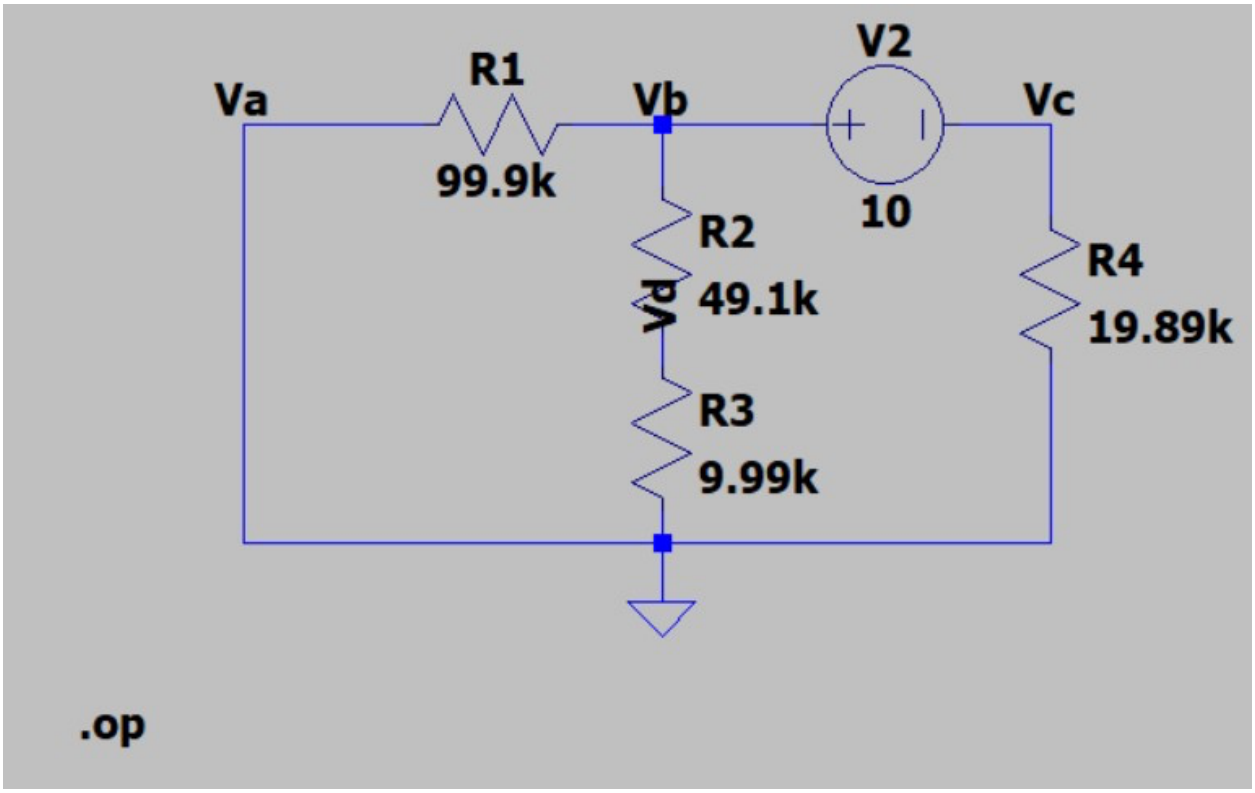
        --- Operating Point ---

V(vc):          0.648234        voltage
V(vd):          0.109593        voltage
V(va):          5               voltage
I(R4):          3.25909e-05     device_current
I(R2):          1.09703e-05     device_current
I(R3):          1.09703e-05     device_current
I(R1):          -4.35612e-05    device_current
I(V1):          -4.35612e-05    device_current
```

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        --- Operating Point ---

V(vc):          -3.48833        voltage
V(vb):          6.51167         voltage
V(vd):          1.10089         voltage
I(R4):          -0.000175381    device_current
I(R2):          0.000110199     device_current
I(R3):          0.000110199     device_current
I(R1):          6.51819e-05     device_current
I(V2):          -0.000175381    device_current
```