



**Department of Electrical and Electronic
Engineering**

INFE 221

Electrical Circuits

Second Lab Session

Resistive Circuits and Fundamental Laws (1)

Kirchhoff's Law

Student Name

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Student Number

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Objective

To formulate a network of resistors aiming to Verify Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL).

Theoretical definitions

Branches, Nodes and Loops A branch represents a single element such that a voltage source or resistor. A node is the point of connection between two or more branches. A loop is any closed path in a circuit. A network with b branches, n nodes and l independent loops will satisfy the following

$$b = l + n - 1 \quad (1)$$

- □ Two elements are in series if they share a single node, consequently carry the same current. On the other hand, two elements are in parallel if they are connected to the same two nodes. Consequently have the same voltage across them.

Example

Consider the circuit drawn below,

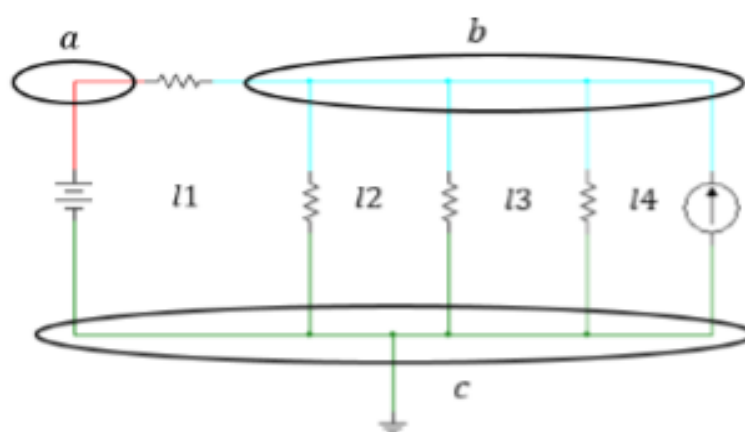


Figure (1): Circuit diagram and illustration of its nodes and independent loops

We can observe that the circuit in Figure 1 has 3 nodes, 4 independent loops and 6 branches satisfy the equation 1.

Kirchhoff's Law

Kirchhoff's Circuit Laws allow us to solve complex circuit problems by defining a set of basic network laws and theorems for the voltages and currents around a circuit.

Kirchhoff's Voltage Law (KVL) states that the algebraic sum of all the voltages around any closed path (loop or mesh) is zero. This idea by Kirchhoff is known as the Conservation of Energy.

Mathematically, KVL implies that

$$\sum_{m=1}^M v_m = 0$$

M is the number of voltages in the loop (number of branches in the loop), v_m is the m th voltage.

Kirchhoff's Current Law (KCL) states that the algebraic sum of all the currents at any node is zero.

Mathematically, KCL given as

$$\sum_{n=1}^N i_n = 0$$

N is the number of branches connected to the node, i_n is the n th current entering or leaving the node.

Practical Section

1- Construct the circuit in Fig 2

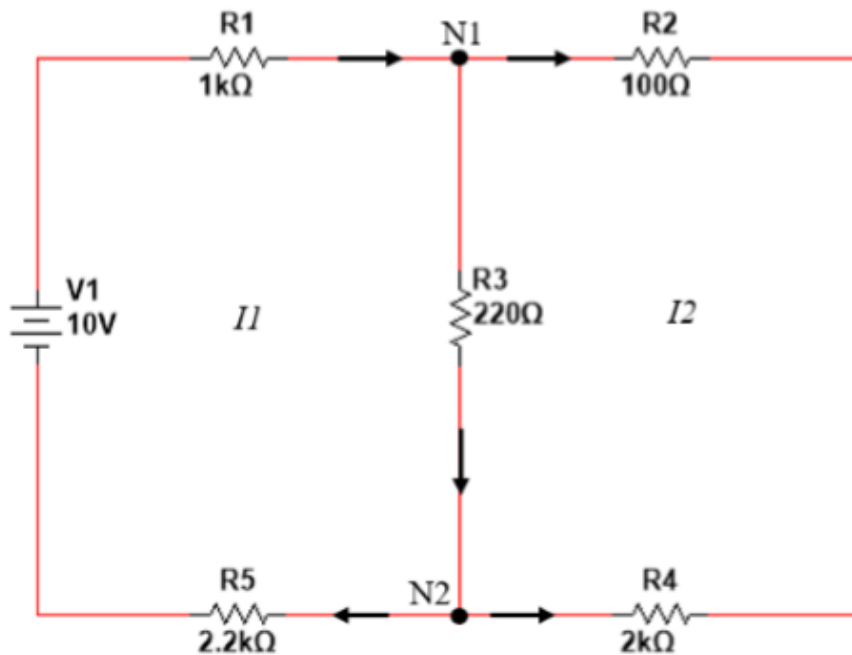


Figure 2: The circuit to be constructed

2- Measure the voltages across each resistor. Then measure the current at each branch by taking care of the directions and tabulate the results in Table 1

Table 1

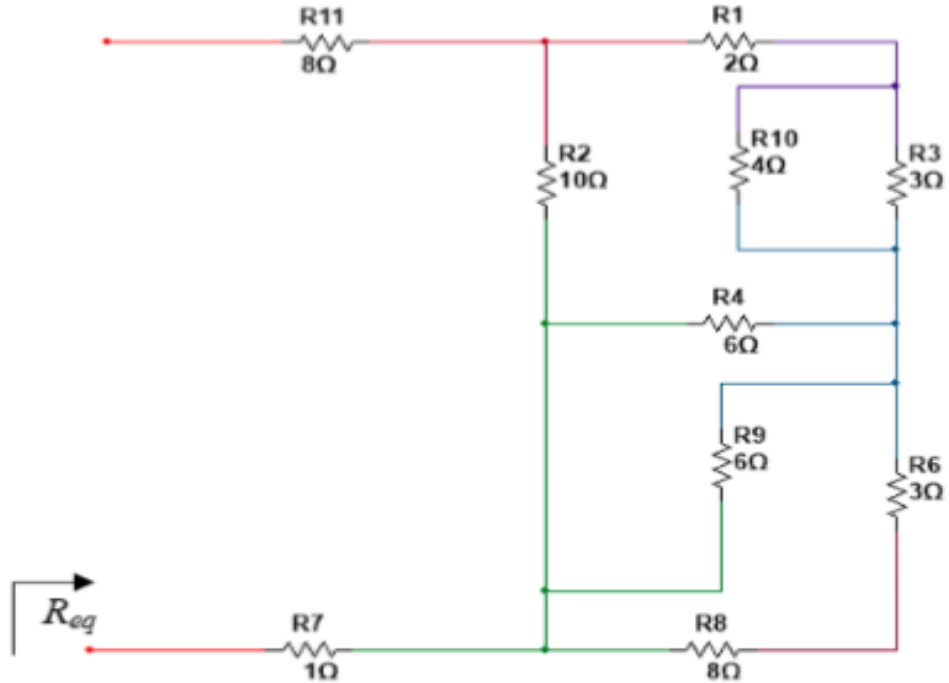
Component	Voltage (V)	Current (mA)
R1		
R2		
R3		
R4		
R5		

3- Are the directions of the currents shown in Fig 2 correct

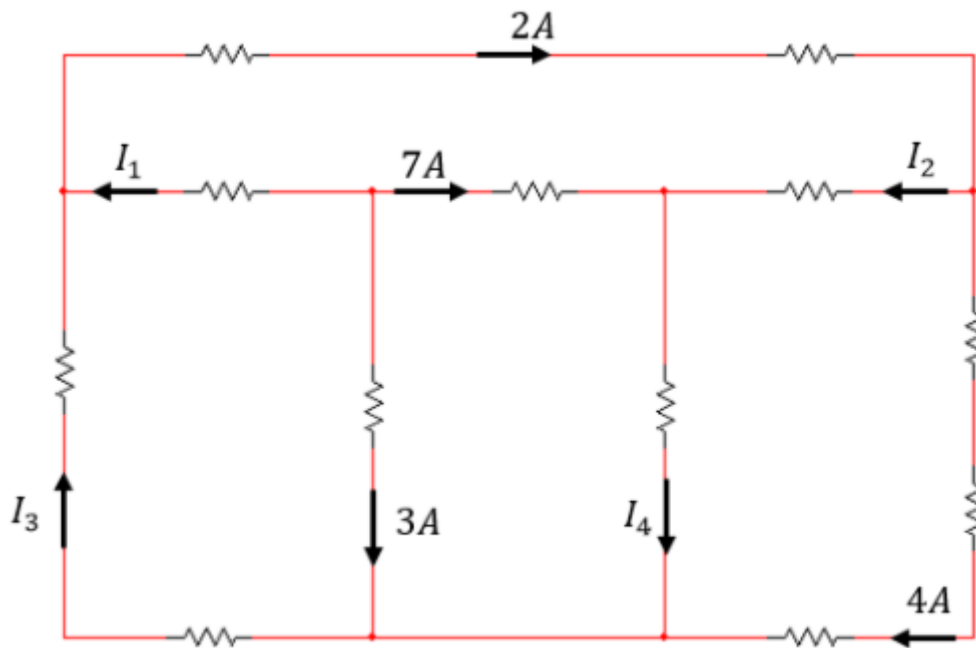
4- 4- Verify Kirchhoff's Voltage Law (KVL) at each of the two independent loops I1 and I2
5- Verify Kirchhoff's Current Law (KCL) at Nodes N1 and N2.

Homework

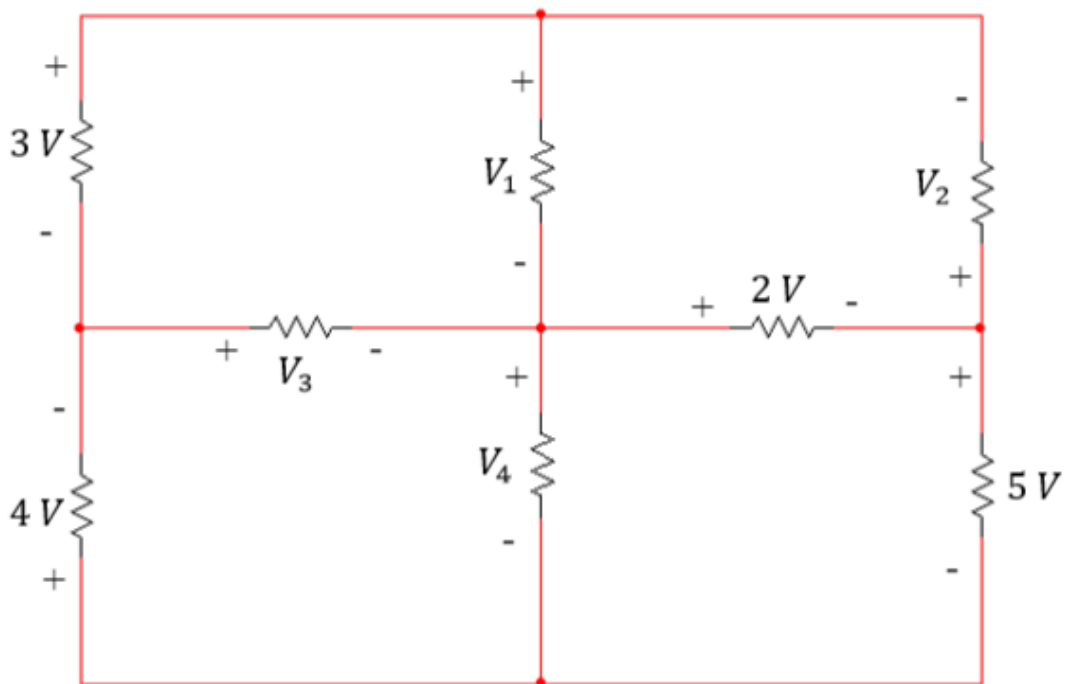
Problem 1: Find the Equivalent Resistance



Problem 2: Use KCL to find the Currents I_1 to I_4



Problem 3: Use KVL to find the Voltages V_1 to V_4



Important Notes

- 1- This Lab session prepared mainly based on the second chapter of the course textbook.
- 2- The students are expected **to print at least the practical section before attending the lab session.**
- 3- **Each group** is responsible for **submitting the practical part in the third Lab session.**
- 4- **Each student** is responsible for **submitting the Homework solutions individually in the third Lab session.** After that the Homework will not be accepted.
- 5- The homework and the practical part solution will be graded and evaluated precisely.
- 6- In case of Cheating, the grade will be zero and there is no possible way to change it.