



UNIVERSITY OF HILLA
College of Engineering Technologies
Department of Medical Devices Technologies

Fundamental of Electrical Engineering(DC)

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First Stage

LAB 4

KIRCHHOFF'S LAW

Exp #4 KIRCHHOFF'S LAWS

Purpose

To verify Kirchhoff's voltage law (KVL) and Kirchhoff's current law (KCL) by comparing voltages obtained from a real circuit to those predicted by Kirchhoff's Laws.

أهداف التجربة:-

تحقيق قانون كيرشوف الأول (KCL) والثاني (KVL) في الدوائر المعقدة التي لا يمكن تبسيطها

Apparatus

2 Power Supply, 3 resistors, an ammeter, breadboard, connectors

الأدوات:-

مصدرين تيار، ٣ مقاومات كهربائية، أميتر، لوحة توصيل، أسلاك توصيل

Circuits

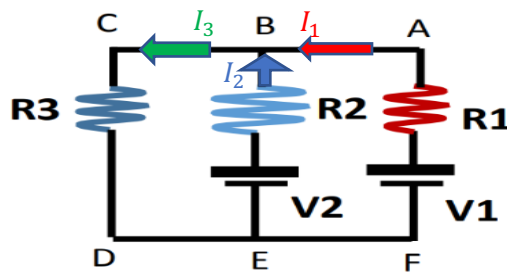


Fig 1

Theory

The two basic laws of electricity that are most useful in analyzing circuits are Kirchhoff's laws for current and voltage.

$$\sum I_{in} = \sum I_{out}$$

Kirchhoff's Current Law (The Junction Rule) states that at any junction (node) of a circuit, the algebraic sum of all the currents is zero (sum of the currents entering the junction equals the sum of the currents leaving the junction). In other words, electric charge is conserved.

$$\sum V_s = \sum R I$$

Kirchhoff's Voltage Law (The Loop Rule) states that around any closed loop or path in a circuit, the algebraic sum of all electric potential differences is equal to zero. To calculate magnitudes of current and voltage in a circuit like Fig. 1, you will need to write three equations, making use of both the loop and junction rules. This results in three equations with three unknowns. For this experiment, you will measure V_i and R_i , then solve for the three currents, I_i .

Equations

$$\sum I_{in} = \sum I_{out} \dots\dots\dots \text{equation (1)}$$

$$\sum V_s = \sum R I \dots\dots\dots \text{equation (2)}$$

symbol	meaning	unit
V	Power source's voltage difference الجهد الكهربائي للمصدر	V
I_{in}	The current entering junction point التيار الداخل لنقطة التفرع	A
I_{out}	The current exit from the junction point التيار الخارج من نقطة التفرع	A
R	Electrical resistance المقاومة الكهربائية	Ω

Procedure

Part I: Assume the direction of the current and apply KCL. Find the nodes (JUNCTIONS) and write the current equation (the selected point is (B))

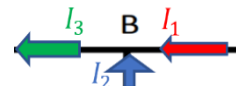
$$\sum I_{in} = \sum I_{out}$$

$$I_1 + I_2 = I_3$$



$$I_1 + I_2 - I_3 = 0$$

1



Part II: Apply KVL. Divide the circuit in close loops and write the voltage equations

$$V_1 = 20 V, \quad V_2 = 12, \quad R_1 = 1000\Omega, \quad R_2 = 680 \Omega, \quad R_3 = 470\Omega$$

Loop1 [ABEFA]	Loop2 [BCDEB]	experimental	theoretical
Apply KVL $\sum V_s = \sum R I$ $-V_2 + V_1 = -R_2 I_2 + R_1 I_1$ $-12 + 20 = -680 I_2 + 1000 I_1$ $1000 I_1 - 680 I_2 + 0 I_3 = 8$ 2	Apply KVL $\sum V_s = \sum R I$ $+V_2 = +R_3 I_3 + R_2 I_2$ $+12 = 470 I_3 + 680 I_2$ $0 I_1 + 680 I_2 + 470 I_3 = 12$ 3	$I_1 =$ $I_2 =$ $I_3 =$	

Rewrite the equations in the general form

$$a x + b y + c z = d$$

$$I_1 + I_2 - I_3 = 0$$

$$1000 I_1 - 680 I_2 + 0 I_3 = 8$$

$$0 I_1 + 680 I_2 + 470 I_3 = 12$$

use Cramer's Rule for a 3×3 System or the calculator

to find the currents value

$$\begin{pmatrix} 1 & 1 & -1 & 0 \\ 1000 & -680 & 0 & 8 \\ 0 & 680 & 470 & 12 \end{pmatrix}$$

Using calculator

Mood-equation5-
choose 2-

$$x = I_1 =$$

$$y = I_2 =$$

$$z = I_3 =$$