



## Lab Report

Department of CSE

Course Title: Introduction to Electrical Engineering Lab

Course Code: EEE 202

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## **Experiment no: 02**

### **Experiment name:** Verification of KVL and KCL

#### **Objective: -**

This experiment is intended to

- (a) verify Kirchhoff's voltage law (KVL)
  - (b) verify voltage divider rule
  - (c) verify Kirchhoff's voltage law (KVL)
  - (d) verify current divider rule
- Learning Outcome: Students will get clear conception about KVL and KCL

#### **Theory:**

##### **KVL:**

The algebraic sum of the potential rises and drops around a closed loop (or path) is zero. Expressed mathematically, KVL states that

Table 1 reports the results of individual voltage drops, the sum of the voltage drops, and the percent error for each of several closed paths in the circuit of Figure 2. As described in the Methods Section, the closed paths were constructed of smaller paths denoted by pairs of nodes; these smaller paths are included in the table entries. The first row in Table 1, for example, corresponds to the closed path drawn in Figure 2. Measurements on other closed paths are similarly indicated.

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

Where  $M$  is the number of voltages in the loop (or the number of branches in the loop) and  $v_m$  is the  $m$ th voltage

. Voltage Divider Rule: The Voltage Divider Rule can be given by

$$V_x = (R_x / R_{eq}) V$$

, Where,

$V$  = voltage across / supplied to any series circuit

$R_{eq}$  = equivalent resistance of the series circuit =  $\sum R_i$   $R_x$  = any particular resistor in the series circuit

$V_x$  = voltage across  $R_x$

. If,  $i = 3$ , then

$$\sum R_i = R_1 + R_2 + R_3$$

## KCL:

KCL states that the sum of the currents entering any node equals the sum of the currents leaving the node.

$\sum I_{\text{entering}} - \sum I_{\text{leaving}} = 0$  The Current Divider Rule is given by

$$I_x = (R_p / R_x) I$$

Where,  $R_p$  is the equivalent resistance of a parallel circuit which is given by the following formula  $R_p = (1/R_1 + 1/R_2 + \dots)^{-1}$

## Apparatus:

1. Resistors:  $1k\Omega$ ,  $\frac{1}{2}$  W;  $2.2k\Omega$ ,  $\frac{1}{2}$  W;  $1.2K\Omega$ ,  $\frac{1}{2}$  W

2. Ammeter(0-10 A)
3. Trainer Board
4. Connecting Wires

### Circuit Diagram:

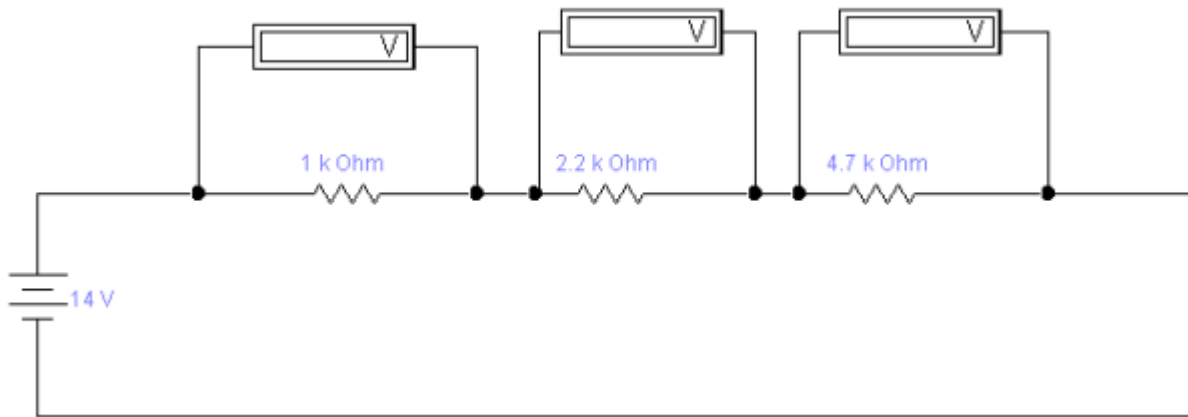


Fig1: Verification of KVL and KCL

### Procedure:

#### KVL:

1. Connect three resistors  $R_1=1K$ ,  $R_2=2.2K$  and  $R_3=4.7K$  in series a DC power supply as shown in fig 2.1.
2. Apply 12 V DC from DC power supply.
3. Take readings of  $V_1$ ,  $V_2$ ,  $V_3$  using a voltmeter .
4. Change the value of  $V_S$  to 10 V and 8 V and repeat step 3 each time.
5. Verify KVL (i.e.  $V_S=V_1+V_2+V_3$ ) for each set of data.

## KCL

i. Connect two resistors  $R_1=1K$  and  $R_2=2.2K$  in parallel with  $R=1.2K$  to a DC power supply as

shown in Figure 2.2. Set  $E = 8V$  from the trainer board.

ii. Take readings of  $I_{1m}$ ,  $I_{2m}$  and  $I_m$  using three ammeters,

ii. Verify KCL (i.e.  $I = I_1 + I_2$ ).

iv. Verify Current Divider Rule (i.e.  $I_{1c} = (R_p/R_1) I_c$  &  $I_{2c} = (R_p/R_2) I_c$ ).

iii. Change the input voltage  $E$  to 10V and 12V. Repeat ii, iii and iv for each case.

## Experimental Data:

### KVL:

No. of Obs.	V (V)	V <sub>1p</sub> (V)	V <sub>2p</sub> (V)	V <sub>3p</sub> (V)	V <sub>p</sub> = (V <sub>1p</sub> + V <sub>2p</sub> + V <sub>3p</sub> ) (V)	% Error, $\frac{V - V_p}{V} \times 100\%$
1	8	1.015	2.231	4.754	$8 = (1.015 + 2.231 + 4.754)$	800
2	10	1.269	2.789	5.942	$10 = (1.269 + 2.789 + 5.942)$	100
3	12	1.523	3.246	7.131	$12 = (1.523 + 3.246 + 7.131)$	1200
4	14	1.777	3.904	8.319	$14 = (1.777 + 3.904 + 8.319)$	1400
5	16	2.030	4.462	9.508	$16 = (2.030 + 4.462 + 9.508)$	1600

## KCL:

No. of Obs.	V (V)	I <sub>1m</sub> A	I <sub>2c</sub> A	I <sub>2m</sub> A	I <sub>m</sub> *=I <sub>1m</sub> +I <sub>2m</sub> A	%Deviati on, $(I_m \sim I_m * I_m) \times 100\%$
1	16	16.39	-48.19	-115.7	16.39=(-48.19)+(-115.7)	1600
2	18	184.3	-54.22	-130.1	184.3=(-54.22)+(-130.1)	1800
3	20	204.8	-60.24	-144.0	204.8=(-60.24)+(-144.0)	2000
4	22	225.3	-66.27	-159.0	225.3=(-66.27)+(-159.0)	2200
5	24	245.8	-72.89	-173.5	245.8=(-72.89)+(-173.5)	2400

## Result:

Table 1 reports the results of individual voltage drops, the sum of the voltage drops, and the percent error for each of several closed paths in the circuit of Figure 1. As described in the Methods Section, the closed paths were constructed of smaller paths denoted by pairs of nodes; these smaller paths are included in the table entries. The first row in Table 1, for example, corresponds to the closed path drawn in Figure 1. Measurements on other closed paths are similarly indicated.

## Discussion:

We have tested the predictions of Kirchhoff's Voltage and Current Laws by measuring the sum of voltages around several closed paths, and the sum of currents at several nodes in two resistive circuits. The "low resistance" circuit was built using resistors in the range of 1[kΩ], and the "high resistance" circuit was built using resistors in the range of 10[MΩ]. Measurements on the low resistance circuit

gave voltage and current sums very close to zero, and thus conformed to the predictions of Kirchhoff's Laws.

Measurements on the high resistance circuit conformed to KCL; however, the sum of voltages around two closed paths in the circuit gave significant errors. We investigated several possible sources of error, but could not account for the discrepancies observed. We suspect that these errors arise from operation of the voltmeter where large resistances are present.