**East West University**

**Lab Report**

**Semester:** Summer-2025

**Course Title:** Electronic Circuits

**Course Code:** CSE209

**Sec:** 01

**Expt. No: 2**

**Expt. Name:** Series-Parallel DC Circuit and Verification of Kirchhoff’s Laws.

**Group No: 5**

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**Date of Submission: 06/08/2025**

# Experiment NO: 02

**Experiment Name:** Series-Parallel DC Circuit and Verification of Kirchhoff’s Laws.

**Objectives:**

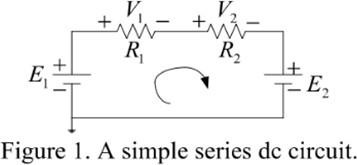
1. To learn analysis of dc series-parallel circuit.
2. To verify Kirchhoff’s Voltage Law (KVL).
3. To verify Kirchhoff’s Current Law (KCL).

**Theory:**

Kirchhoff’s Voltage Law (KVL)states that **the sum of the voltage rises around a closed** path is equal to the sum of the voltage drops. The KVL can be written in the following mathematical form:

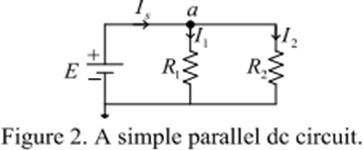
### Ʃ V rises = Ʃ V drops

The sum of the voltage rises and the sum of the voltage drops are to be calculated in a given direction (normally in the clockwise direction). For example, in the simple series circuit of Figure 1, there are two voltage sources *(E*1and *E*2) and two resistors (*R*1and *R*2) The voltage drops across the two resistors are *V*1 and *V*2, respectively. If we write KVL equation for the clockwise direction, then the KVL equation will be



Kirchhoff’s Current Law (KCL) states that **the sum of the currents entering anode of a circuit is equal to the sum of the currents leaving the node.** The KCL can be written in the following mathematical form:



For example, in the simple parallel circuit of Figure 2, there is a voltage source (E) and two resistors (R1 and R2). The source current drawn from the voltage source is Is. The currents through resistors R1 and R2 are I1 and I2 , respectively. If we consider the node a of the circuit, then Isis enters the node and I1 and I2 are leaving the node. Then, the KCL equation forthe node a is

*I*s= *I*1 + *I*2

A series-parallel circuit is one that is formed by a combination of series and parallel resistors. For solving series-parallel circuits, parallel combinations of resistors and series combination of resistors are clearly identified. Then the series-parallel reduction method is used to determine the values of the circuit variables. For example, in the simple

series-parallel circuit of Figure 3, the resistors *R1* and *R*2 are in parallel and this parallel combination is in series with the resistor *R*1. As the resistors *R*2 and *R*3 are in parallel, *V*2 = *V*3 . Let *Rp = R*2 || *R*3. Then, the equivalent resistance of the

series-parallel combination is *Req = R1 +Rp.* Now, the circuit variables can be calculated using the formulas

*I* 1 =

𝐸

𝑅

𝑒𝑞

𝑉 =

1

𝐼 𝑅

1 1

𝑉 = 𝑉

2 3

= 𝐼 𝑅

1 𝑝

𝑉

2

*I* 2 = 𝑅

2

𝑉

3

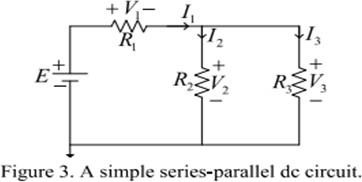
*I* 3 = 𝑅3

The KVL equations for the circuit of Figure 3 can be written as

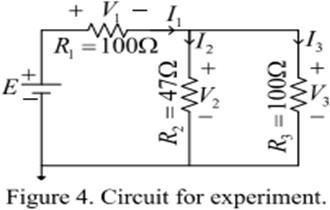
*E = V1*+ *V*2 *E = V1*+ *V3*

The KCL equation for the circuit of Figure 3 can be written as

*I*1 = *I*2 + *I*3



**Circuit Diagram:**

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# Pre-Lab Report Questions:

1. Theoretically calculate the values of *E, V1*,*V2*, *V3, I1*, *I2* and *I*3 of the circuit of Figure4 with E =3V.

# Ans:

Given that,

𝑅

1

𝑅

2

=100Ω

= 47Ω

## 𝑅 = 100Ω

3

## 𝐸 = 3V

Here, 𝑅 & 𝑅

2 3

### is in parallel connection.

So, 𝑅 = ( 1 + 1

𝑝 𝑅 𝑅3

2

= ( 1 + 1

47 100

)−1 Ω

)−1 Ω

##### = 31.98Ω

Now, 𝑅 and

𝑝

### 𝑅 is in series connection.

1

### So, 𝑅 = 𝑅 + 𝑅

𝑒𝑞 𝑝 1

## =(31.98+100)Ω

##### = 131.98 Ω

We know that,

*I* 1 =

𝐸

𝑅

𝑒𝑞

3

= 131.98 A

### So, 𝐼 =0.022A

1

Here,

= 0.022A

## 𝑉 =𝐼 𝑅 =0.022×100=2.27V

1 1 1

𝑉 =𝐼 𝑅 =0.022×31.98=0.73V

2 2 𝑃

𝑉 =𝐼 𝑅 =0.022×31.98=0.73V

3 3 𝑃

𝑉

2

*I* 2 = 𝑅

2

0.73

= 47 =0.015A

𝑉

3

*I* 3 = 𝑅

3

0.73

= =0.0073A

100

1. From the calculated values, show that (i) *V2 = V3*, (ii) KVL holds, that is,

*E=V1*+ *V*2, and (iii) KCL holds, that is, *I1 = I2 + I3*.

**Ans:**

#### i.

##### 𝑉 =𝑉 =0.72V

2 3

***ii.***

From the calculated value we get that,

𝑉1+𝑉2

= (2.23+0.72) V

=3V

***iii***

*I* 2 + *I* 3=(0.015+0.007)A

## =0.022A

**Experimental Datasheet**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Measured Value of *E (V)* | Measured Value of *V*1 *(V)* | Measured Value of  *V*2 *(V)* | Measured Value of *V*3*(V)* | Measured Value of  *I*1(mA) | Measure d Value of *I*2  (mA) | Measured Value of  *I*3 (mA) | Measured Value of Resistances (Ω) |
| 3 | 2.3 | 0.9 | 0.7 | 22 | 7 | 13 | *R*1=97.8 |
| *R*2=98.9 |
| *R*3=48.2 |
| 5 | 3.7 | 1.3 | 1.1 | 33 | 11 | 20 | *R*1=97.8 |
| *R*2=98.9 |
| *R*3=48.2 |

# Post-Lab Report Questions:

1. Calculate the values of *V1*, *V2*, *V3, I1*, *I2* and *I*3 of the circuit of Figure 4 using measured values of *E, R1*and *R2*. Compare the calculated values with the measured values and give reason if any discrepancy is found.

**Ans:**

So,

Given, E = 3V

Here, R2 & R3 are in parallel.

1 1 1

=

𝑅 𝑅

+ 𝑅

𝑝 2 3

= 1 +

98.9

1

49.2 Ω

## Rp = 32.85 Ω

And R1 & Rp are in series,

Req = R1 + Rp= 97.8 Ω + 32.85 Ω = 130.62 Ω

Now,

*I* 1 =

=

𝐸

𝑅

𝑒𝑞

3 A

130.62

##### = 0.023A

##### = 23mA

V1 = I1R1 = 0.023×97.8 = 2.25 V

V2 = V3 = I1Rp = 0.023×32.85 = 0.76V

𝑉

2

𝐼 =

𝑅

2

2

= 0.76 A

98.9

##### =0.008A = 8mA

𝐼 =

3

=

𝑉

3

𝑅

3

0.76 A

48.2

##### =0.016A = 16mA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Measured Value of *E*  (V) | Measured Value of  *V*1 (V) | Measured Value of  *V*2 (V) | Measured Value of  *V*3 (V) | Measured Value of *I*1 (mA) | Measured Value of *I*2 (mA) | Measured Value of *I*3 (mA) | Measured  Value of  Resistances (Ω) |
| 3 | 2.3 | 0.9 | 0.7 | 22 | 7 | 13 | *R*1=97.8 |
| *R*2=98.9 |
| *R*3=48.2 |
| Calculated | Calculated | Calculated | Calculated | Calculated | Calculated | Calculated | Calculated |
| Value of E  (V) | Value of V1 (V) | Value of V2 (V) | Value of V3 (V) | Value of *I*1  (mA) | Value of *I2*  (mA) | Value of *I3*  (mA) | Value of |
|  |  |  |  |  |  |  | Resistances |
|  |  |  |  |  |  |  | (Ω) |
| 3 | 2.25 | 0.76 | 0.76 | 23 | 8 | 16 | *R*1= 100 |
| *R*2= 47 |
| *R*3= 100 |

Table 2. The discrepancy between theoretical and measured values of V1, V2, V3, I1, I2, I3, R1,

The calculated and measured values for voltages V1, V2, and V3 show relatively small differences, which could be attributed to measurement inaccuracies. However, the calculated and measured values for currents I1 , I2, and I3 exhibit significant discrepancies, suggesting potential measurement errors or incorrect units. It's essential to double-check the measurement equipment, units, and calibration to ensure accurate readings for current values.

1. From the calculated values of *V1*,*V2*, *V3, I1*, *I2* and *I*3, show that (i)*V2 = V3*,(ii)*E*

*=V1*+ *V*2 (KVL), and (iii)*I1 = I2 + I3* (KCL).

**Ans:**

From the calculated values,

V1 = 2.25V V2 = 0.76V V3 = 0.76V I1 = 0.023A I2 = 0.008A I3 = 0.016A E = 3V

#### i

Here, we can see that V2 = V3; (As R2 & R3 are in parallel and in parallel circuit voltages are Same).

#### ii

Again,

##### V1 + V2 = 2.25V + 0.76V = 3.1V

So, we can say that, E = V1 + V2

#### iii

Here,

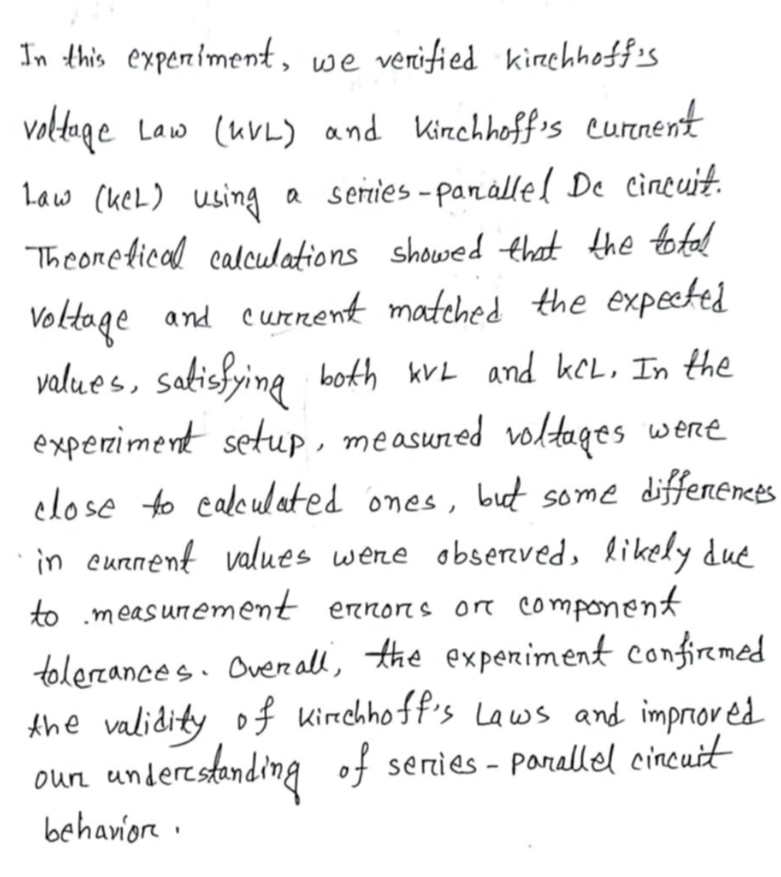
##### I2 + I3 = 0.008A + 0.016 A

= 0.024A

= I1

So, we can say that, I1 = I2 + I3

**Discussion:**

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