Experiment No: 05

Name of Experiment: To investigate the characteristics of a series DC circuit and a parallel DC circuit and to verify Kirchoff's Voltage Law (KVL) and to verify Kirchoff's Current Law (KCL).

Data Sheet:

Table 3.1:

Nominal values of Resistance (Ω)	**Measured values of Resistance by Ohmmeter (Ω)**	**Equivalent Resistance, R_T**		**Measured voltage across each resistor (V)**	**Calculated Voltage using VDR (V)**
		Measured R_T by using Ohmmeter(Ω)	**Calculated R_T = $R_1+R_2+R_3$ (Ω)**		
R_1= 50	52.5	250	50+90+115=255	**V_1=** 7.84	7.843
R_2= 90	94.5			**V_2=** 14.12	14.118
R_3= 115	120.75			**V_3=** 18.04	18.039

Calculation:

$I = \frac{V_S}{R_T} = \frac{40}{255} = 0.15686 = 0.16$ A.

$R_1 = V_1/0.16 = 7.84/0.16 = 49$ ohm

$R_2 = V_2/0.16 = 14.12/0.16 = 88.25$ ohm

$R_3 = V_3/0.16 = 18.04/0.16 = 112.75$ ohm

Therefore,

Sum of $R_{T\text{ (by using ohmmeter)}}$ = 49+88.25+112.75= 250 Ω

Here, $V_s = 40\ volt$

$V_1 = (R_1/R_T) \times V_s = (50/255) \times 40 = 7.843$ Volt

$V_2 = (R_2/R_T) \times V_s = (90/255) \times 40 = 14.118$ Volt

$V_3 = (R_3/R_T) \times V_s = (115/255) \times 40 = 18.039$ Volt

Therefore,

Sum of V_L = 7.843+14.118+18.039 = 40 volt

According to KVL,

$V_{gain} = V_{lost}$

$V_{gain} = V_s$ = 40 Volt (Theoretical value)

$V_{lost} = V_L$ = 7.843+14.118+18.039 = 40 Volt (Experimental value)

%Error: $\frac{|40-40|}{40} \times 100\% = 0\%$

Accuracy: (100% - %Error) = 100%-0%= 100%.

Now,

$R_{T \text{ (by using ohmmeter)}} = 250\ \Omega$

Theoretical, $R_T = 255\ \Omega$

%Error: $\frac{|255-250|}{255} \times 100\% = 1.96\%$

Accuracy: (100% - %Error) = 100%-1.96%= 98.04%.

<u>Assignment:</u>

What can you deduce about the characteristics of a series Circuit from observation Table 3.1?

Answer:

Series circuit is a circuit where two or many resistances are placed accordingly at a particular line. In figure 3.1, we can see such a circuit. From Table 3.1, we can notice that R_T is the sum of all the three resistors. We can observe information from that table that relates to the characteristics of a series circuit. We know in series circuit the voltages per resistances are not same. They are always different.

From the data found in Table 3.1, mathematically prove that the current in the series network of figure 3.3 is equal for each resistance.

Answer:

In figure 3.3,

$R_1 = 50\Omega$, $R_2 = 90\ \Omega$, $R_3 = 115\ \Omega$

From the Table 3.1,

$V_1 = 7.84$ Volt, $V_2 = 14.12$ Volt, $V_3 = 18.04$ Volt

$I_1 = 0.15684 = 0.16$ A,

$I_2 = 0.156821 = 0.16$ A,

$I_3 = 0.15686 = 0.16$ A.

Therefore,

$I_1 = I_2 = I_3$ (Verified).

Verify KVL from the data obtained in Table 3.1.

Answer:

From Table 3.1,

V_s = 40 Volt

I = $\frac{V_s}{R_T}$ = $\frac{40}{250}$ = 0.16 A.

$V_1 = IR_1$ = 7.84 volt

$V_2 = IR_2$ = 14.12 volt

$V_3 = IR_3$ = 18.04 volt

$V_s + (-IR_1) + (-IR_2) + (-IR_3) = 0$

$\rightarrow$ 40-7.84-14.12-18.04 = 0

$\therefore \sum v = 0$ (KVL verified)

Data Sheet:

Table 4.1:

Nominal values of Resistance (Ω)	Measured values of Resistance by Ohmmeter (Ω)	Equivalent Resistance, R_T		Measured current through each resistor (A)	Calculated Current using CDR (A)
		Measured R_T by using Ohmmeter(Ω)	Calculated $\frac{1}{R_T}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}$ (Ω)		
R_1= 40	42	21.127	21.086	I_1= 0.75	0.749
R_2= 75	48.75			I_2= 0.40	0.399
R_3= 110	115.05			I_3= 0.27	0.272

Calculation:

V_s = 30 Volt

$R_1 = \frac{v}{I_1} = \frac{30}{0.75}$ = 40 ohm

$R_2 = \frac{v}{I_2} = \frac{30}{0.40}$ = 75 ohm

$R_3 = \frac{v}{I_3} = \frac{30}{0.27}$ = 111.11 ohm

Therefore,

Sum of $R_{T \text{ (by using ohmmeter)}}$ = 21.127 ohm

I_T = 0.75+0.40+0.27 = 1.42 A.

$I_1 = (R_T/R_1) \times I_T$ = (21.086/40) × 1.42 = 0.749 A

$I_2 = (R_T/R_2) \times I_T$ = (21.086/75) × 1.42 = 0.399 A

$I_3 = (R_T/R_3) \times I_T$ = (21.086/110) ×1.42 = 0.272 A

Therefore,

Sum of I_L = 0.749+0.399+0.272 = 1.42 A

According to KCL,

$I_{in} = I_{out}$

I_{in}= I_T = 1.42 A

I_{out} = I_L = I_1+I_2+I_3= = 0.749+0.399+0.272 = 1.42 A

%Error: $\frac{|1.42-1.42|}{1.42} \times 100\% = 0\%$

Accuracy: (100% - %Error) = 100%-0%= 100%.

Now,

$R_{T\ (experimental)}$ = 21.127 Ω

$R_{T\ (theoretical)}$ = 21.086 Ω

%Error: $\frac{|21.127-21.086|}{21.086} \times 100\% = 0.194\%$

Accuracy: (100% - %Error) = 100%-0.194%= 99.806%.

Assignment:

What can you deduce about the characteristics of a parallel circuit from observation Table 4.1?

Answer:

Parallel circuits are arranged such that current can Travel through different branches simultaneously. In figure 4.4, we can see such a circuit. From Table 4.1, we can notice that $\frac{1}{R_T}$ is the sum of all the three Resistors. We can observe information from that table that relates to the characteristics of a parallel circuit. Here, the voltage remains constant in every resistance.

From the data found in Table 4.1, Calculate I_1, I_2 and I_3 using Ohm's Law.

Answer:

From Table 4.1,

R_1 = 40 Ω, R_2 = 75 Ω, R_3 = 110Ω, V_s= 30 Volt
Using Ohm's Law,
I_1 = V/ R_1 = 30/40 = 0.75 A
I_2 = V/ R_2 = 30/75 = 0.40 A
I_3 = V/ R_3 = 30/110 = 0.27 A

Verify KCL from the data obtained in Table 4.1.

Answer:

From Table 4.1,

$I_{in} = I_{out}$

$I_{in} = I_T = 1.42$ A

$I_{out} = I_1+I_2+I_3 = 0.749+0.399+0.272 = 1.42$ A

$I_T - (I_1+I_2+I_3) = 0$

$\rightarrow 1.42-(0.749+0.399+0.272) = 0$

$\therefore \sum I = 0$ (KCL verified)

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