Theory

Kirchoff's current law is a law described by German's physicist Gustav Kirchoff's that is used in the study of parallel circuit. It states that the sum of all current is entering a circuit junction is equal to the sum of the current's leaving it. The algebraic sum of the current's meeting in a node is equal to zero. Some conductor's have current's leading to node where as some have current's leading away from node. Assuming the incoming current to be positive and the outgoing current is negative.
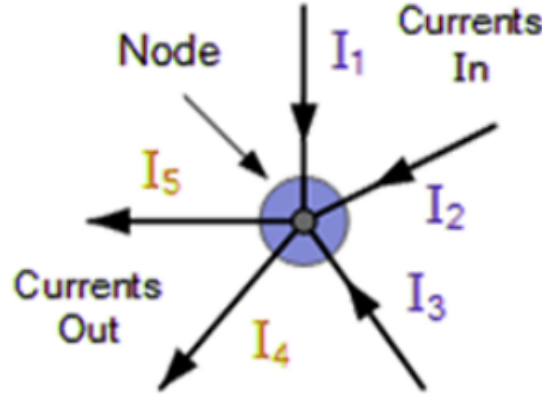

Figure 1: Kirchoff's Current Law

Applying *KCL* at node we have,

$$I_1 + I_2 + I_3 - I_4 - I_5 = 0$$

$$\implies I_1 + I_2 + I_3 = I_4 + I_5$$

Consider a circuit with 3 resistor in a parallel (R_{T_1}) and as same circuit another two resistors in parallel (R_{T_2}) then total equivalent values of resistance (R_T) is given by-

$$R_T = R_{T_1} + R_{T_2} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}} + \frac{R_4 \times R_5}{R_4 + R_5} \tag{1}$$

So, for first three parallel resistors voltage is given by-

$$V_1 = \frac{V}{R_1} \times R_{T_1} \tag{2}$$

Again, as same as for R_4 and R_5 two parallel resistors voltage is given by -

$$V_2 = \frac{V}{R_T} \times R_{T_2} \tag{3}$$

A equation to measure each resistor's current flow is given by-

$$I = \frac{V}{R} \tag{4}$$

Apparatus

- Multimeter

- Wire

- DC power circuit

- Trainer Board

- Resistors $(2.65 K\Omega, 3.86 k\Omega, 10.02 k\Omega, 2.695 k\Omega, 8.53 k\Omega)$

Procedure

- At first, we had to connect the power source and turn on the switch and check if everything functioned properly.

- Then we took five resistors of different values using the multimeter the value of the five resistors were checked.

- Three of the resistors were first connected in parallel and that arrangement was connected in series with the other two resistors which were connected in parallel themselves.

- We used the multimeter and Knobs to calibrate the voltage we wished to use.

- After setting up the voltage the parts for three wires on the multimeter were charged and connected to the circuit so that we could calculate the total current (I_s)

- Then we calculated the theoretical result of the total resistance (R_s) using the equation
$$R_s = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}} + \frac{R_1 \times R_2}{R_1 + R_2} \tag{5}$$

- After calculated total resistance, then we calculated the theoretical result of current using the equation
$$I_s = \frac{V}{R_T} \tag{6}$$

- After completing resistance we calculated voltage (V_1) of three parallel resistors (R_1, R_2, R_3) and calculated each resistor's current flow (I_1, I_2, I_3). Similarly, we calculated voltage (V_2) and current flow of (I_4, I_5) of other two parallel resistors (R_4, R_5).

- Then we calculated theoretical and practical value of $I_e(I_1 + I_2 + I_3)$ and $I_o(I_4 + I_5)$ where I_e is summation of current leading to node and I_o is summation of current away from node.

- These procedures were followed five times for each resistors.

- After that we calculated the error of the practical result comparing with I_e and I_o using the equation

$$\left| \frac{I_o - I_e}{I_e} \right| \times 100\% \tag{7}$$

- Finally, we calculated the average error and confirmed that it was under 5%

Result

Volt.	I_s		I_1		I_2		I_3		I_4		I_5	
	The	Prac	The	Prac	The	Prac	The	Prac	The	Prac	The	Prac
2.16	0.634	0.63	0.324	0.32	0.222	0.21	0.083	0.08	0.48	0.47	0.151	0.15
4.98	1.46	1.45	0.747	0.74	0.512	0.51	0.197	0.19	1.1057	1.105	0.349	0.34
8.14	2.38	2.37	1.22	1.21	0.836	0.83	0.322	0.32	1.807	1.80	0.571	0.57
12.05	3.537	3.53	1.811	1.80	1.24	1.23	0.479	0.47	2.68	2.682	0.847	0.84
15.06	4.42	4.41	2.27	2.26	1.55	1.54	0.600	0.588	3.354	3.35	1.1059	1.05

Table 1: Result of difference reading

Voltage	$I_e = I_1 + I_2 + I_3$		$I_o = I_4 + I_5$		Practical $\left\| \frac{I_o - I_e}{I_e} \right\| \times 100\%$
	Theo.	Pra.	Theo.	Prac.	
2.16	0.629	0.61	0.631	0.62	1.63
4.98	1.456	1.44	1.454	1.445	0.347
8.14	2.378	2.36	2.378	2.37	0.423
12.05	3.53	3.5	3.52	3.522	0.628
15.06	4.42	4.388	4.413	4.4	0.273

Table 2: Error Chart

Discussion

The experiment was done very carefully and every connection were checked before measuring the current so that measurement is quite accurate. The difference between the current we got from the multimeter's reading and the theoretical value is very low. And, if we look average error (%), we can see that it is lower than 2%. So, with that in mind we can say that this experiment has been done successfully.