Basic Electrical and electronic Engineering (EEE1001)

NAME: O G Ragavi

REG.NO: 20BCE1988

LAB EX: 1

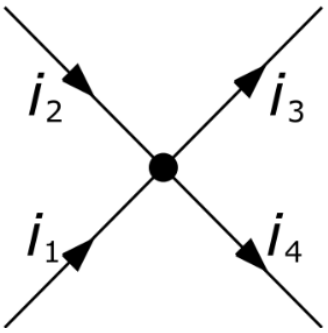
TITLE: Verification of Kirchhoff's current law

Aim:

To verify Kirchhoff's current law using LTSpice software.

Theory:

Kirchhoff's current law states that for any node (junction) in an electrical circuit, the sum of currents flowing into that node is equal to the sum of currents flowing out of that node. The algebraic sum of the currents in a network of conductors meeting at a point is zero.



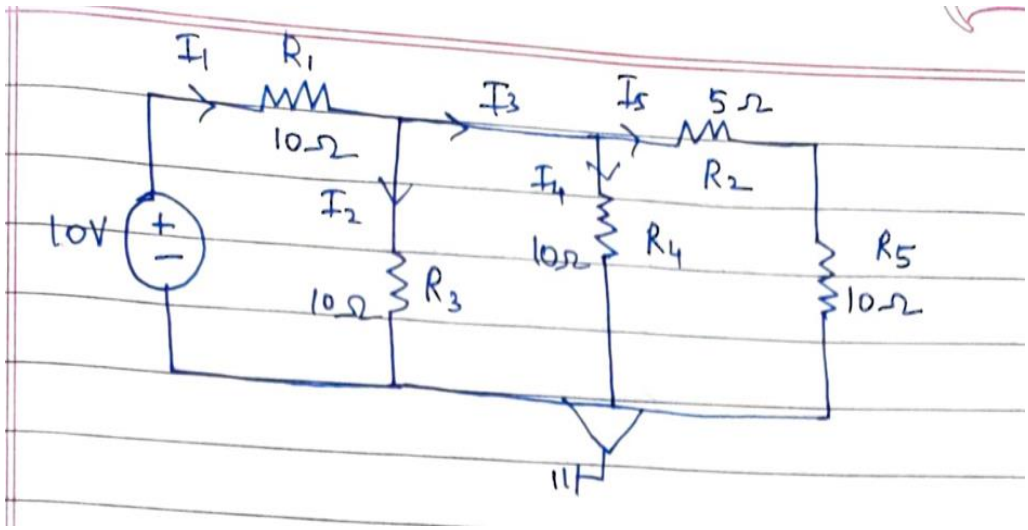
Formula:

The current entering the junction = The current leaving the junction

Equation: **i1+i2=i3+i4**

1.Simulation:

Circuit Diagram:



Theoretical calculation:

Theoretical calculation:

Resistance:

$Req_1 = R_2 + R_5 = 5 + 10 = 15\Omega$

$Req_2 = Req_1 \parallel R_4 = 15\Omega \parallel 10\Omega$

$\Rightarrow \frac{15 \times 10}{15+10} = \frac{150}{25} = 6\Omega$

$Req_3 = Req_2 \parallel R_3 = 6\Omega \parallel 10\Omega$

$\Rightarrow \frac{6 \times 10}{6+10} = \frac{60}{16} = 2.5\Omega$

$Req_4 = R_1 + Req_3$

$= 2.5 + 10$

$= 12.5\Omega$

$\therefore \boxed{Req = 12.5\Omega}$

Current :

$I_1 = \frac{V}{Req} = \frac{10}{12.5} = 0.8A$

$I_2 = 0.8 \times \frac{6}{16} = 0.3A$

$I_3 = 0.8 \times \frac{10}{16} = 0.5A$

$I_4 = 0.5 \times \frac{15}{25} = 0.3A$

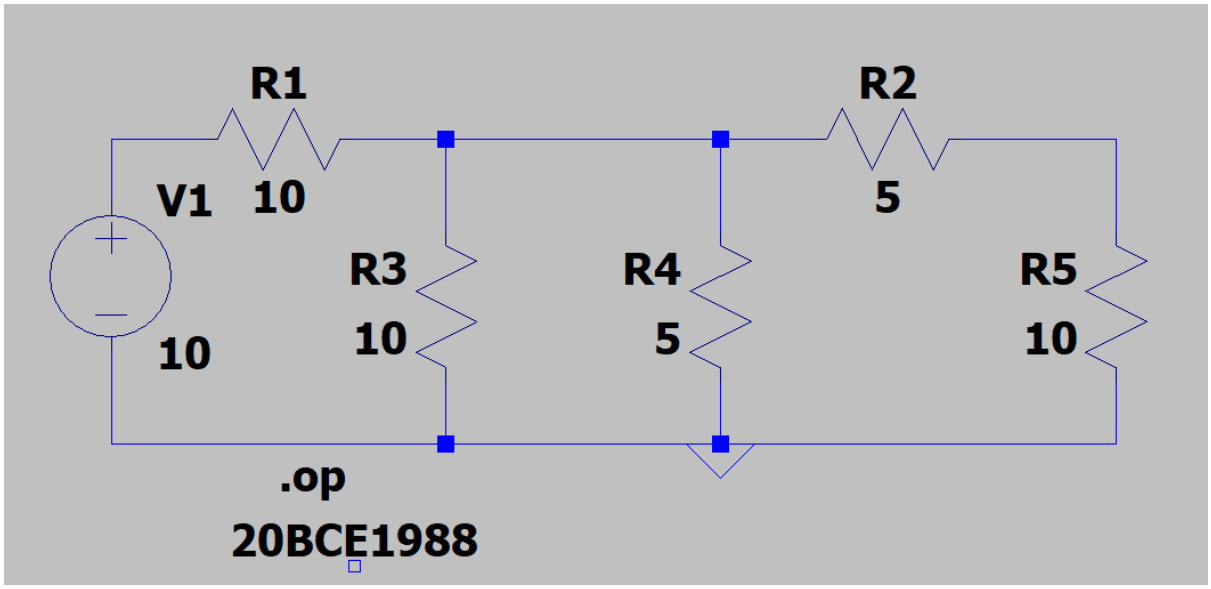
$I_5 = 0.5 \times \frac{10}{25} = 0.2A$

$\therefore V_1 = I_1 \times R_1 = 10V$

$\therefore V_2 = I_3 \times R_2 = 0.3 \times 10 = 3V$

$V_4 = 10V$; $V_5 = 3.33V$; $V_6 = 6.67V$

Simulation diagram:



Simulation Result:

* C:\Users\ragav\OneDrive\Documents\LTspiceXVII\Draft1.asc

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       --- Operating Point ---

V(n001):        10              voltage
V(n002):        2.14286         voltage
V(n003):        1.42857         voltage
I(R5):          -0.142857       device_current
I(R4):          -0.428571       device_current
I(R3):          -0.214286       device_current
I(R2):          -0.142857       device_current
I(R1):          -0.785714       device_current
I(V1):          -0.785714       device_current
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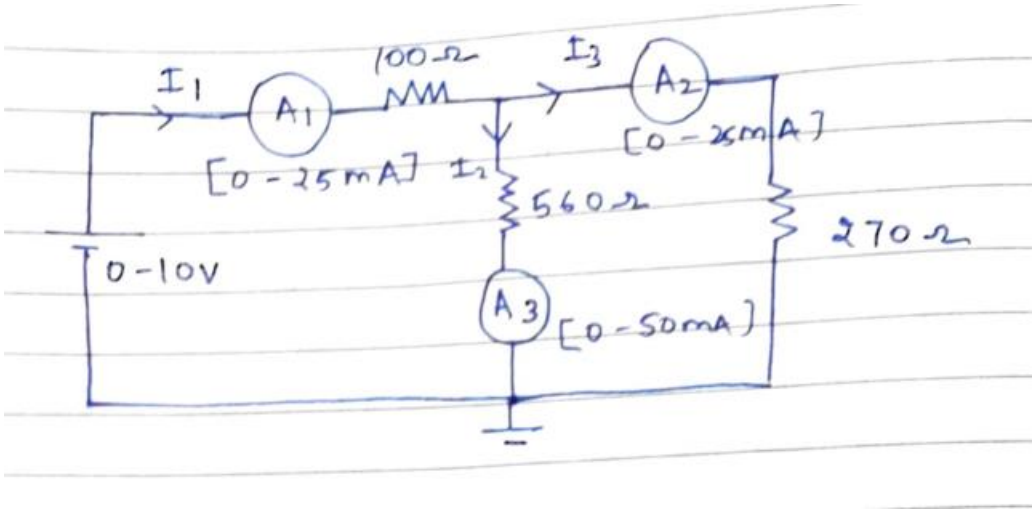
2.Experiment Verification:

Circuit Diagram:



Theoretical calculation:

Theoretical calculation:

$$R_{eq} = 100 + \frac{270 \times 560}{270 + 560} = 282.169\ \Omega$$

$$V_{max} = 10V$$

$$I_1 = \frac{10}{282.169} = 0.0354 = 35.4\ mA$$

$$I_2 = \frac{270}{270+560} \times I_1 = 11.528\ mA$$

$$I_3 = \frac{560}{270+560} \times I_2 = 23.911\ mA$$

Tabular column:

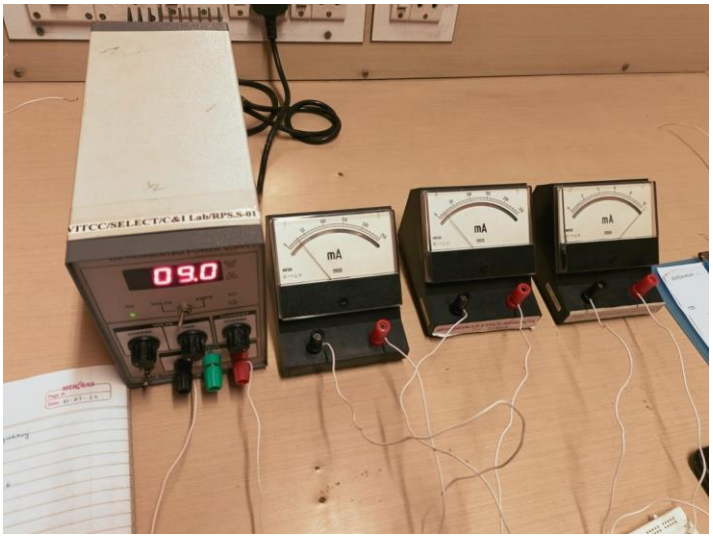
Result Table:

V (volts)	A_1 (milli amps)	A_2 (milli amps)	A_3 (mA)
2	10	5	3.2
4	14	5	4.6
6	15	10	5.8
8	20	10	7
10	23	12	8.2

Experiment Result:

The current increases as the voltage increases and the current I_1 is roughly the sum of I_2 and I_3. The inaccuracies could mainly be the

errors in multiple ammeters, but the trend for all values of V remains the same.



Result:

The Kirchhoff's current law is verified by LTSpice simulation and experimentation.