Ex. No.: 1 Date: 25.7.2019

Verification of KIRCHHOFF'S LAWS

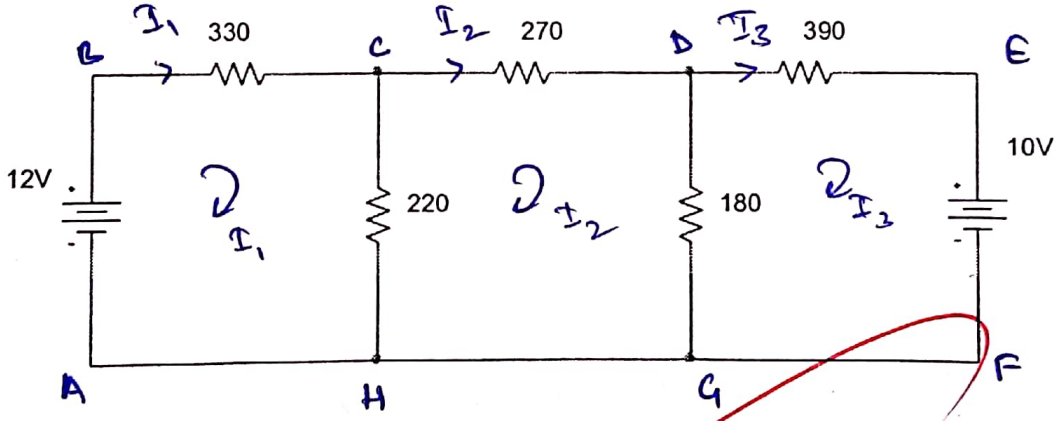
(Mesh and Nodal Analysis)

Aim: To verify the Kirchoff's current law and voltage law for the given network by theoriticlly and experimentally.

Apparatus/Tool required:

Sl. No.	Components Name	Range	Quantity
1	Resister	330Ω, 270Ω, 390Ω, 220Ω, 180Ω	Each 1 No.
2	Ammeter	0-50mA (DC)	1 No.
3	Voltmeter	0-30V (DC)	1 No.
4	RPS	0-32 V (DC)	1 No.
5	Connecting Wires	-	Few
6	Bread Board	-	1 No.

Circuit Diagram:



Theory:

Kirchhoff's Current Law (KCL): The algebric sum of the current at any function is zero.

$$\Sigma I = 0$$

Kirchhoff's Voltage Law (KVL): The algebric sum of the voltage will be zero at any closed loop.

$$\Sigma V = 0$$

Mannual

~~Practical~~ Circuit ~~and output:~~

~~Mesh Analysis:~~

ABGHA - (1)

$12 - 330I_1 - 220(I_1 - I_2) = 0$

$12 - 330I_1 - 220I_1 + 220I_2 = 0$

$12 - 550I_1 + 220I_2 = 0$

$$\boxed{550I_1 - 220I_2 = 12} \quad - (1)$$

EDGHC - (11)

$-270I_2 - 180(I_2 - I_3) - 220(I_2 - I_1) = 0$

$-270I_2 - 180I_2 + 180I_3 - 220I_2 + 220I_1 = 0$

$$\boxed{220I_1 - 670I_2 + 180I_3 = 0} \quad - (2)$$

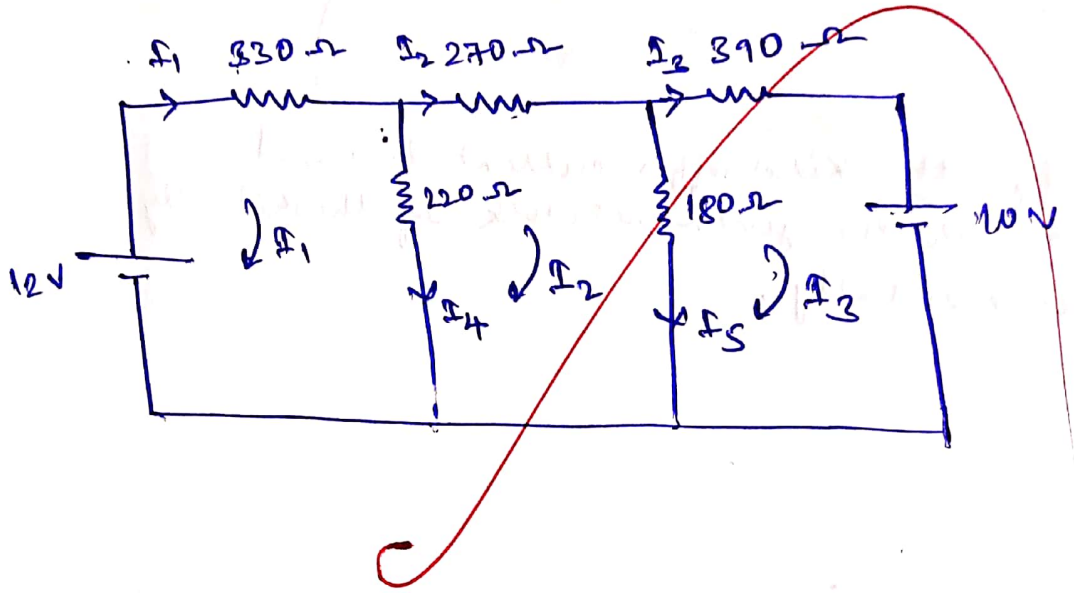
DEFGD - (111)

$-340I_2 - 10 - 180(I_3 - I_2) = 0$

$-340I_3 - 10 - 180I_3 + 180I_2 = 0$

KVL Proof!

$550 \times 23.06 \times 10^{-3} - 220 \times 3.12 \times 10^{-3} = 12$



Practical

~~Manual~~ Calculations:

Mesh Analysis

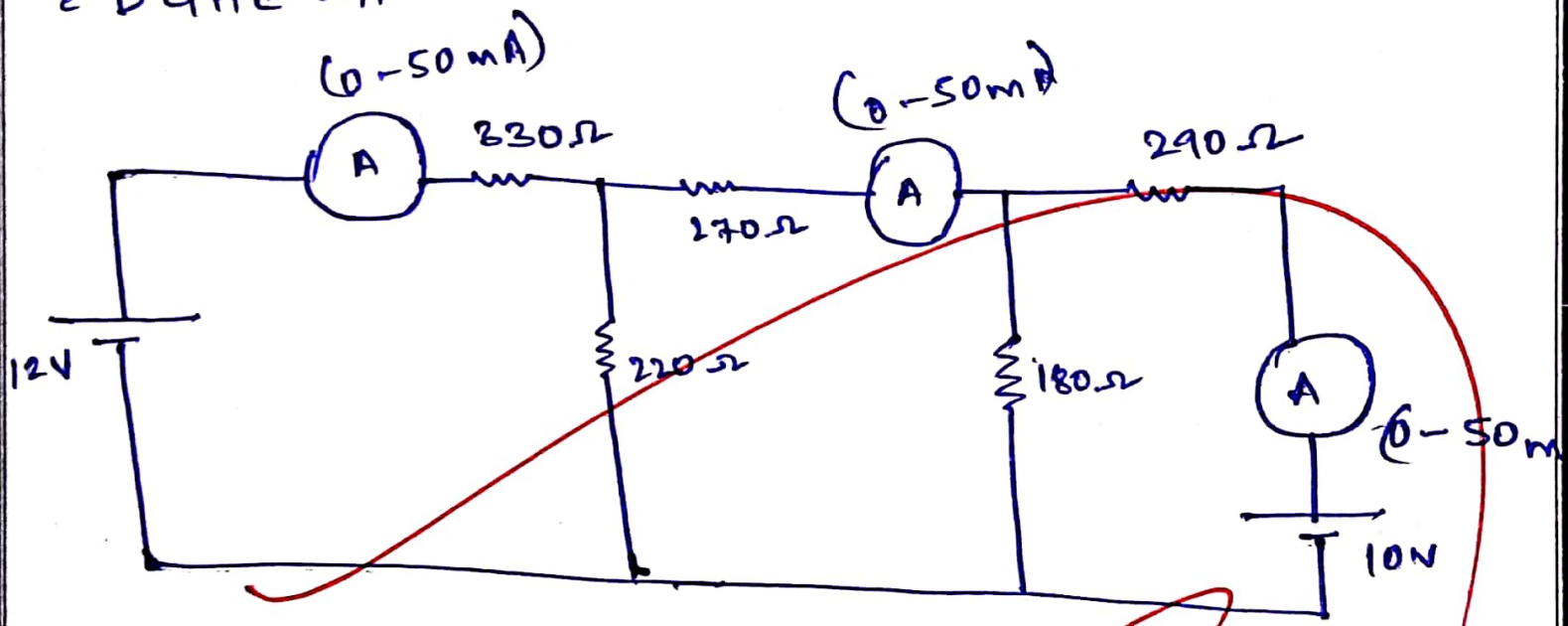
ABGHA – 1

$12 - 330 I_1 - 220 (I_1 - I_2) = 0$

$12 - 330 I_1 - 220 I_1 + 220 I_2 = 0$

$$550 I_1 - 220 I_2 = 12$$

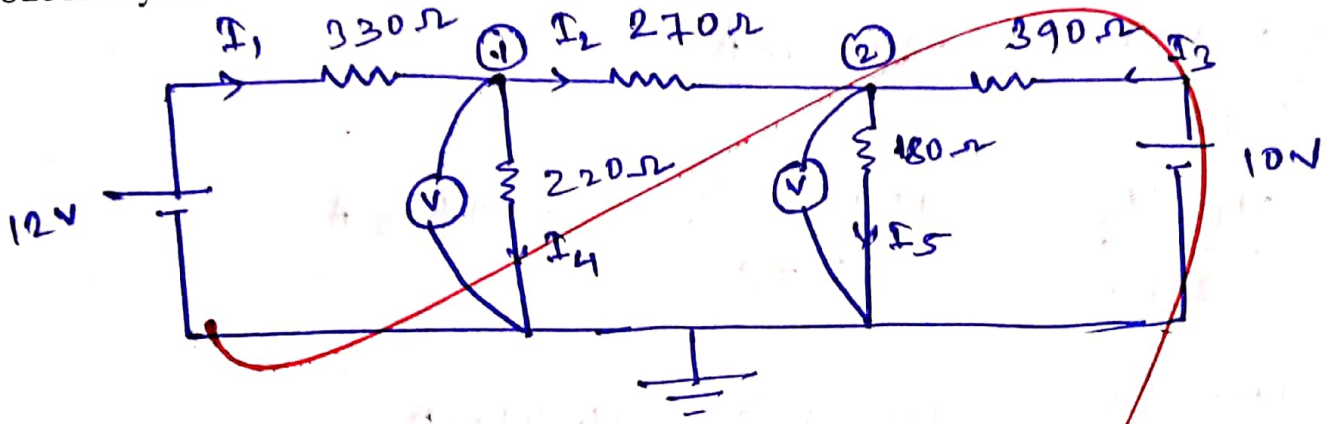
e DGHC – 11

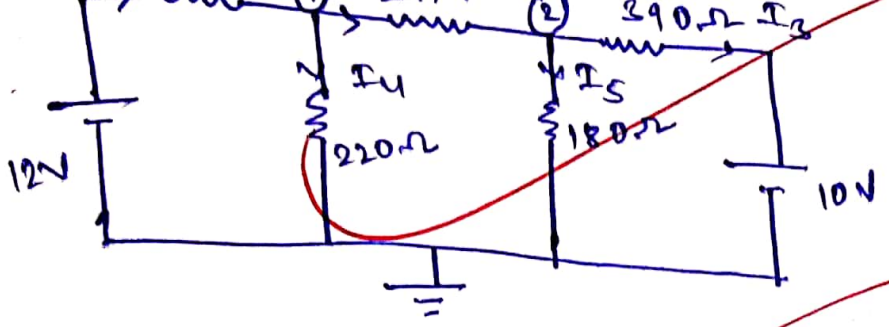


I_1 (mA)	23
I_2 (mA)	3
I_3 (mA)	16
$I_1 - I_2 = I_4$ (mA)	20

Practical Circuit and output:

Node Analysis:





At node (1)

$$I_1 = I_2 + I_4 \quad - (i)$$

$$I_1 = \frac{12 - V_1}{330} \quad - (ii), \quad I_2 = \frac{V_1 - V_2}{270} \quad - (iii), \quad I_4 = \frac{V_1 - 0}{220}$$

$$\Rightarrow \frac{12 - V_1}{330} = \frac{V_1 - V_2}{270} + \frac{V_1}{220}$$

$$\Rightarrow \frac{12}{330} - \frac{V_1}{330} - \frac{V_1}{270} + \frac{V_2}{270} - \frac{V_1}{220} = 0$$

$$\Rightarrow \frac{12}{330} - V_1\left(\frac{1}{330} + \frac{1}{270} + \frac{1}{220}\right) + \frac{V_2}{270} = 0$$

$$\Rightarrow \boxed{-0.011274V_1 + 0.0037V_2 = -0.0364} \quad - (v)$$

At node (2) :

$$I_3 + I_2 = I_5 \quad - (vi)$$

$$I_3 = \frac{10 - V_2}{390} \quad - (vii), \quad I_2 = \frac{V_1 - V_2}{270} \quad - (viii), \quad I_5 = \frac{V_2 - 0}{180}$$

$$\Rightarrow \frac{10 - V_2}{390} + \frac{V_1 - V_2}{270} = \frac{V_2}{180}$$

$$\Rightarrow \frac{10}{390} - \frac{V_2}{390} + \frac{V_1}{270} - \frac{V_2}{270} - \frac{V_2}{180} = 0$$

$$\frac{V_1}{270} - V_2\left(\frac{1}{390} + \frac{1}{270} + \frac{1}{180}\right) + \frac{10}{390} = 0$$

$$\boxed{0.00037\,V_1 - 0.01182\,V_2 = -0.0256}$$

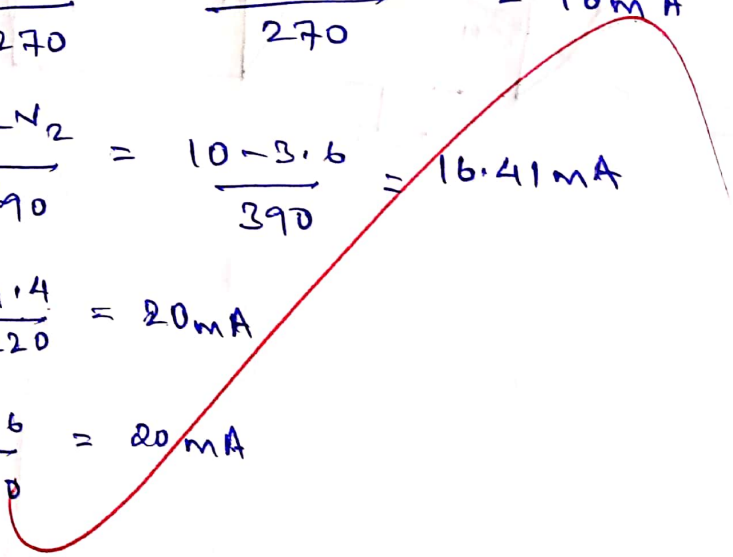
$$I_1 = \frac{12 - 4.4}{330} = 23.03\,mA$$

$$I_2 = \frac{V_1 - V_2}{270} = \frac{4.4 - 3.6}{270} = 2.96\,mA$$

$$I_3 = \frac{10 - V_2}{390} = \frac{10 - 3.6}{390} = 16.41\,mA$$

$$I_4 = \frac{4.4}{220} = 20\,mA$$

$$I_5 = \frac{3.6}{180} = 20\,mA$$



Procedure:

Result: The verification of KCL and KVL has been verified for the given network by theoritically and experimentally and the following results are tabulated.

Mesh Analysis:

Manual Calculations

Practical output

Parameters	Theoritical Value (mA)	Exp. Value (mA)
I_1	23.06	23
I_2	3.12	3
I_3	-16.56	-16

Node Voltage Analysis:

Manual Calculations

Practical output

Parameters	Theoritical Value (V)	Exp Val. (V)
V_1	4.4	4.3
V_2	3.6	3.5

Inference:

25/07/19

Verified

Reg. No: 19BCE2074	Name: KULVIR SINGH	Date: 25.07.19