Circuit Diagram:

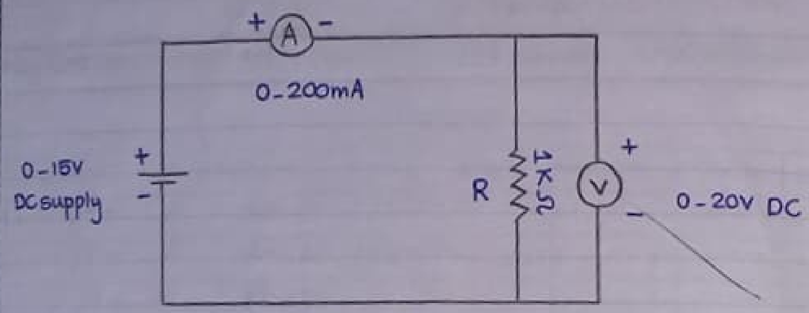


Figure-1

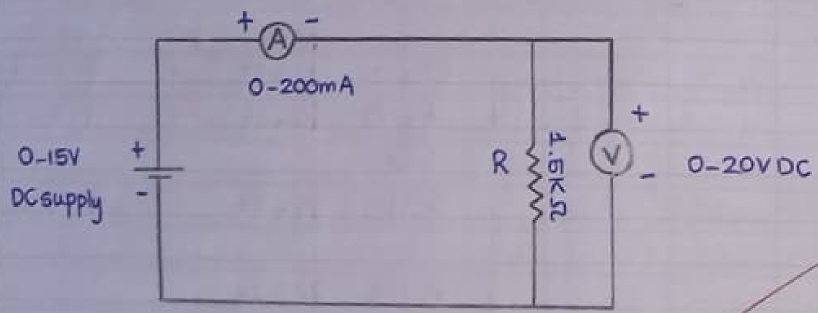


Figure-2

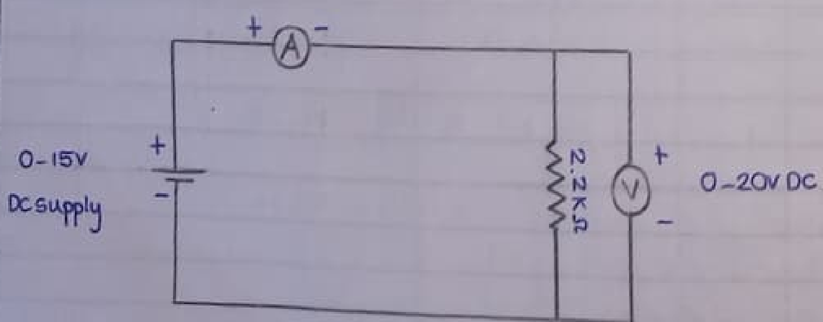


Figure-3

Experiment No.1 : Verification of ohm's Law

Aim: To verify the Ohms Law for given resistive network

Statement: It states that the voltage across the Conductor is directly propotional to the current flowing through it, provided all physical conditions & temp. remains constant.

Apparatus Required:

S.No.	Apparatus Name	Range	Type	Quantity
1	Regulated power Supply	(0-30)V	DC	01
2	voltmeter	(0-20)V	DC	01
3	Ammeter	(0-200)mA	DC	01
4	Resistor	1, 1.5, 2.2KΩ	variable	Required
5	ohm law kit.	-	-	01
6	Connecting wires	-	-	Required

Observation Table :

(i) At 1kΩ Resistance

S.No.	voltage (V)	Current (A)	Resistance (ohm's)
1	4.76	4.8	1kΩ
2	8.28	8.6	1kΩ
3	12.18	12.9	1kΩ

(ii) At 1.5kΩ Resistance

S.No.	voltage (V)	current (A)	Resistance (ohm's)
1	4.16	3.1	1.5kΩ
2	8.16	5.5	1.5kΩ
3	12.12	7.3	1.5kΩ

(iii) At 2.2kΩ Resistance

S.No	voltage (V)	current (A)	Resistance (ohm's)
1	4.45	2.0	2.2kΩ
2	8.22	3.7	2.2kΩ
3	12.49	6.0	2.2kΩ

Procedure:

★ Make the Connections as per circuit Diagram

★ Switch ON the power supply to RPS and Apply a voltage (10V) and take Reading of voltmeter and Ammeter

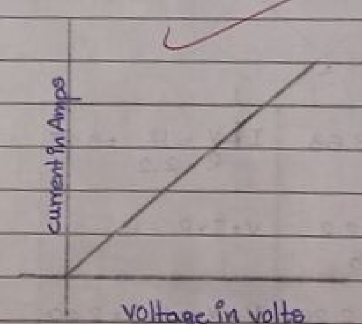
★ Adjust the Rheostat in steps and take down the Readings of Ammeter and voltmeter.

★ Plot and graph with Along x-axis and I along Y-Axis

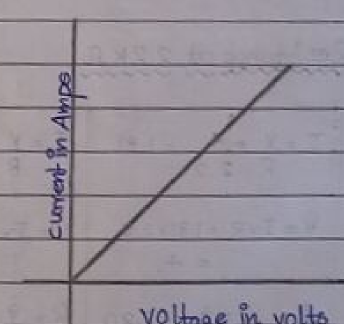
★ The Graph will be straight line which verifies ohm's law

★ Determine the slope of V-I graph. The reciprocal of the slope gives resistance of the wire.

Model Graph:



VOLTAGE & CURRENT FOR 15Ω



VOLTAGE & CURRENT FOR 25Ω

Calculation for ohm's Law:

(i) Resistance at $1K\Omega$

$I = \frac{V}{R} = \frac{4}{1} = 4$	$I = \frac{V}{R} = \frac{8}{1} = 8$	$I = \frac{V}{R} = \frac{12}{1} = 12$
$V = I \times R = 4$	$V = I \times R = 8$	$V = I \times R = 12$
$R = \frac{V}{I} = 1$	$R = \frac{V}{I} = 1$	$R = \frac{V}{I} = 1$

(ii) Resistance at $1.5K\Omega$

$I = \frac{V}{R} = \frac{4}{1.5} = 2.66$	$I = \frac{V}{R} = \frac{8}{1.5} = 5.33$	$I = \frac{V}{R} = \frac{12}{1.5} = 8$
$V = I \times R = 4$	$V = I \times R = 8$	$V = I \times R = 12$
$R = \frac{V}{I} = 1.50$	$R = \frac{V}{I} = \frac{8}{5.33} = 1.50$	$R = \frac{V}{I} = 1.50$

(iii) Resistance at $2.2K\Omega$

$I = \frac{V}{R} = \frac{4}{2.2} = 1.81$	$I = \frac{V}{R} = \frac{8}{2.2} = 3.63$	$I = \frac{V}{R} = \frac{12}{2.2} = 5.45$
$V = I \times R = 1.81 \times 2.2 = 4$	$V = I \times R = 3.63 \times 2.2 = 8$	$V = I \times R = 12$
$R = \frac{V}{I} = \frac{4}{1.81} = 2.20$	$R = \frac{V}{I} = \frac{8}{3.63} = 2.20$	$R = \frac{V}{I} = \frac{12}{5.45} = 2.20$

Precautions:

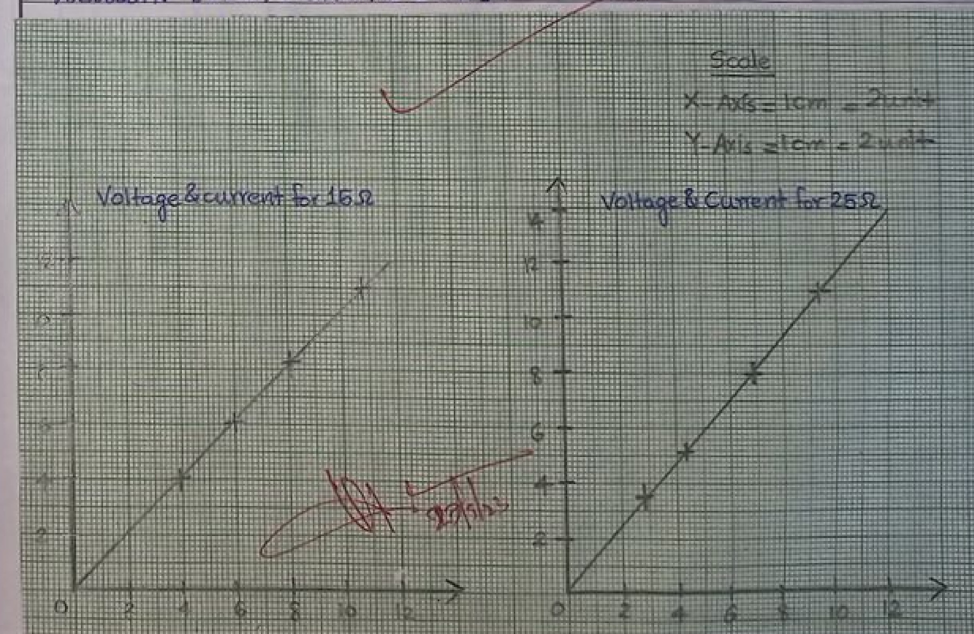
★ Take Care of connecting the Ammeter and voltmeter

★ Make sure of proper colour coding of resistors

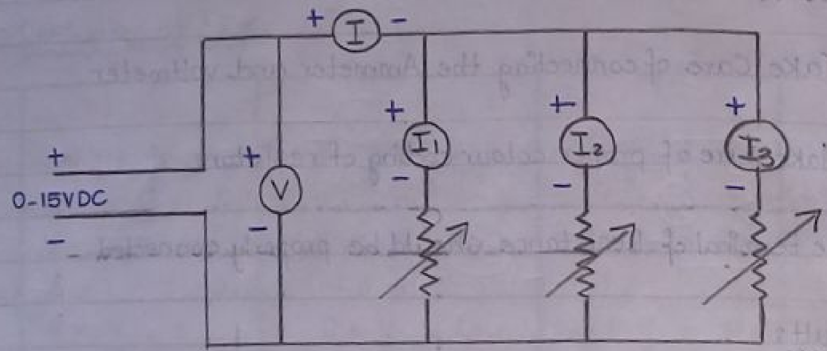
★ The terminal of Resistance should be properly connected.

Result:

Hence, we proved ohm's law for a given resistivity network [$1K\Omega$, $1.5K\Omega$, $2.2K\Omega$].



Circuit Diagram of KCL :



Theoritical values of KCL :

S.No.	voltage E volts	Current I	I_1	I_2	I_3	$I_1 = I_2 + I_3$
1	5	11.3	5.3	3.6	2.4	6.0
2	10	20.9	9.95	6.7	4.4	11.1
3	15	32.1	14.8	9.97	6.9	16.87

Practical values of KCL :

S.No.	voltage E volts	Current I	I_1	I_2	I_3	$I_1 = I_2 + I_3$
1	5	11.7	5.4	3.8	2.5	6.3
2	10	21.5	10	6.9	4.6	11.5
3	15	32.5	15	10.3	6.8	17.1

Date : 27|09|23

Experiment - 1(B) : Verification of Kirchoff's Law

Aim : Verify Kirchoff's current law and Kirchoff's voltage law for a given circuit.

Apparatus Required :

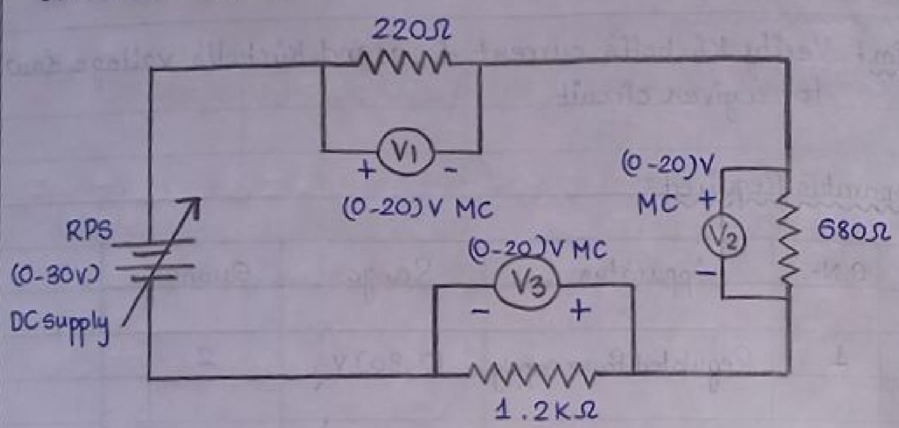
S.No.	Apparatus	Range	Quantity
1	Regulated Power supply	(0-30) V	2
2	Resistance	220Ω, 680Ω 1.2KΩ, 1.5KΩ	6
3	Ammeter	(0-30)mA MC	3
4	Voltmeter	(0-30V) MC	3
5	BreadBoard & wires	–	Required

Statement :

Kirchoff's current law : The Algebraic sum of the currents meeting at node is equal to zero

Kirchoff's voltage law : In any closed Path / mesh, the Algebraic sum of all voltages is zero.

Circuit Diagram of KVL:



Theoriticalvalues of KVL:

S.No.	volts (V_S)	V_1	V_2	V_3	$E_1 = V_1+V_2+V_3$
1	4	0.86	1.35	2.0	4.21
2	10	2.10	3.27	4.85	10.22
3	14	2.95	4.58	6.78	14.31

Practical values of KVL:

S.No.	volts (V_S)	V_1	V_2	V_3	$E_1 = V_1+V_2+V_3$
1	4	0.85	1.27	1.87	3.99
2	10	2.12	3.18	4.66	9.96
3	14	2.97	4.4	6.63	13.9

Procedure for KCL:

★ Give the Connections as per the circuit Diagram

★ Set a particular value in RPS

★ Note down the Corresponding Ammeter Reading

★ Repeat the same for different voltages

Procedure for KVL:

★ Give the Connections as per circuit Diagram

★ Set a particular value in RPS

★ Note down All the voltage Reading

★ Repeat the same for different voltages

Calculations of KVL:

$$I = \frac{V}{R} = \frac{V}{R_{eq}} = \frac{4V}{(1+1.5+2.2)\times 10^3 \Omega}$$

$$I = \frac{4}{4.7\times 10^3 \Omega} \Rightarrow I = 0.851\times 10^{-3} A \Rightarrow I = 0.851 mA$$

$$V_1 = IR_1 = 0.851\times \cancel{10^{-3}} \times 1\times \cancel{10^3} \Rightarrow V_1 = 0.851$$

$$V_2 = IR_2 = 0.851\times \cancel{10^{-3}} \times 1.5\times \cancel{10^3} \Rightarrow V_2 = 1.276$$

$$V_3 = IR_3 = 0.851\times \cancel{10^{-3}} \times 2.2\times \cancel{10^3} \Rightarrow V_3 = 1.872$$

$$\Rightarrow V = V_1 + V_2 + V_3 = 3.999 V = 4V$$

Calculations of KCL:

$$I = I_1 + I_2 + I_3$$

$$I_1 = \frac{V}{R_1}, \ I_2 = \frac{V}{R_2}, \ I_3 = \frac{V}{R_3}$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{R_2 . R_1}{R_1 + R_2} = \frac{1.5\times \cancel{10^6}^{3}}{2.5\times \cancel{10^3}} \Rightarrow \frac{0.6\times 10^3 \times 2.2\times 10^3}{2.8\times 10^3} = 471\Omega$$

$$I = \frac{V}{R_{eq}} = \frac{10}{471} = 0.212A \Rightarrow \{I = 21.2mA\}$$

$$I_1 = \frac{V}{R_1} = \frac{10}{1\times 10^3} = 10mA, \ I_2 = \frac{V}{R_2} = \frac{10}{1.5\times 10^3} = 6.66mA, \ I_3 = \frac{V}{R_3} = 4.54mA$$

$$\Rightarrow I = I_1 + I_2 + I_3$$

$$\Rightarrow [10 + 6.66 + 4.54] mA \Rightarrow 21.2 mA$$

Precautions:

★ Check for proper connections before switching ON

★ Make sure of proper colour coding of resistors. the terminal of the resistance should be connected.

Result: {For KCL}

We can say that KCL values are theoritically and practically are proved by Applications

Result for KVL

We can say that KVL values are theoritically and Practically are proved by Applications.

4/10/23

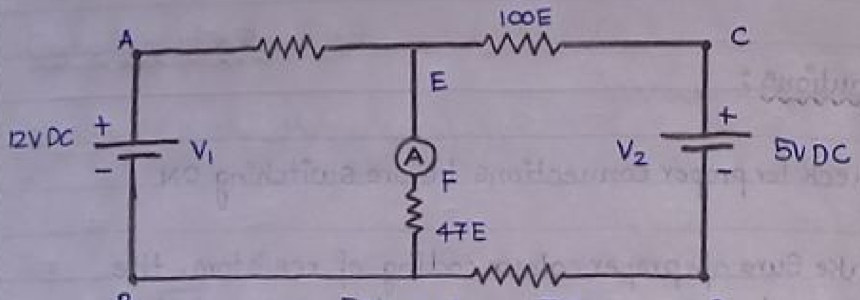


Figure-1

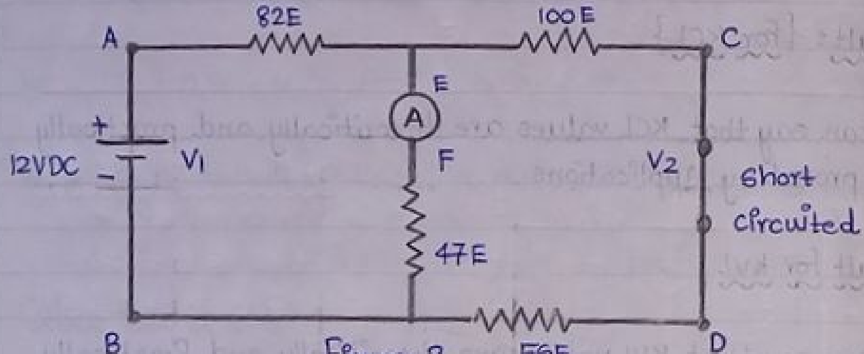


Figure-2

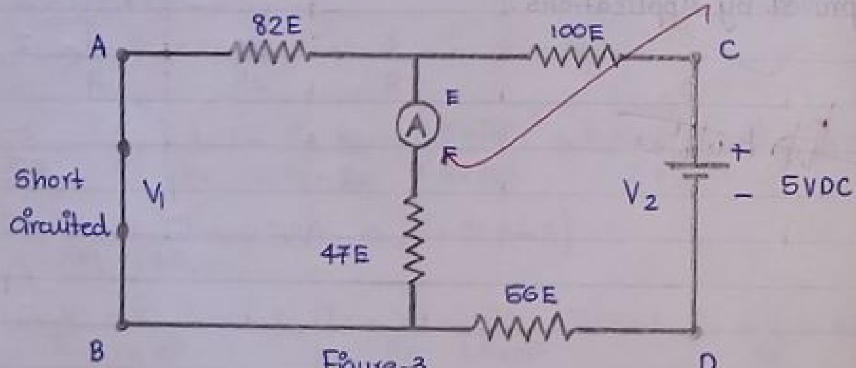


Figure-3

Date : 04/10/23

Experiment-02 : Verification of Superposition Theorem

Aim: To Verify Superposition theorem theoritically & Practically

Statement: Which States that in any Linear network containing 2 or more sources, the response in any element is equal to algebraic sum of the responses caused by individual sources acting alone with other sources are reduced to zero.

Apparatus Required:

S.No.	Equipment	Range	Type	Quantity
1	Ammeter	(0-200)mA	MC	01
2	RPS	(0-30)V	MC	02
3	SP theorem kit	–	–	01
4	Resistors	82,100,47,56Ω	Fixed	Each 01
5	Connecting wires	–	–	As Required

Observation Table :

S.No.	Voltage (V_1)	Voltage (V_2)	Theoritical	Practical
1	12	5	93 (I)	93.8 (I)
2	12	0	77 (I')	77.1 (I')
3	0	5	16 (I'')	17.2 (I'')

Theoritical Calculations :

$V \to R = 0 \Rightarrow$ Low

$I \to R = \infty \Rightarrow$ very high

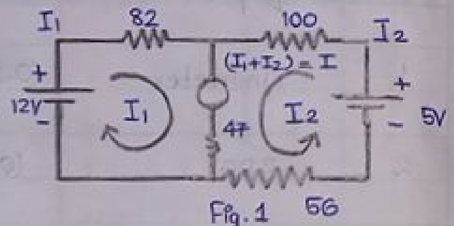
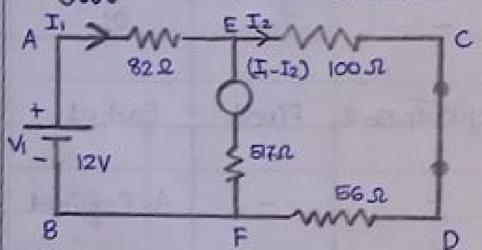


Fig. 1

Case-1 : $V_2 \to$ short circuited



$I_1 = \frac{\text{opp res.}}{Req} \times \text{total current}$

$I_1 = \frac{156\Omega}{156+47} \times 0.162 \approx 0.77A$

$\Rightarrow$ 77mA

$I_1 = \frac{V}{Req} \Rightarrow Req = 100\Omega \,\&\, 56 = 100 + 56 = 156\Omega$

156 and 47 in Parallel $\Rightarrow \frac{156 \times 47}{156+47} = 3612\Omega$, 82 & 36Ω are in series

$Req = 118.12\Omega \Rightarrow V_1 = 12V$

$I_1 = \frac{V}{Req} = \frac{12}{118.12} = 0.102A \Rightarrow \{I' = 77mA\}$

Procedure :

★ Connect the circuit as shown in Figure 1

★ Apply 12V in RPS 1V and 5V in RPS 2

★ Note down the Ammeter Reading as I

★ Connect the circuit Diagram as shown in Fig. 2

★ Apply 12V in RPS 1 and Take Ammeter as I'.

★ Connect the circuit Diagram as shown in Fig. 3

★ Apply 5V in RPS 2 and Take Ammeter as I''

★ According to super position theorem, I = I' + I''

Precautions :

(i) Check for proper connection before switching ON the supply

(ii) Make sure of proper colour coding of resistors

(iii) Terminal of Resistance should be connected.

Case-2: $V_1 \rightarrow$ short circuited

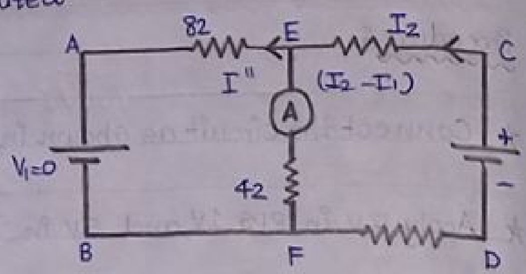


Figure - 2

$$\left\{ I'' = \frac{82}{82+47} \times I_2 \right\}$$

$$I_2 = \frac{V_2}{R_{eq}}$$

$$R_{eq} = (82 // 47) + 156\Omega$$

$$= \left[\frac{82 \times 47}{82+47}\right] + 100\Omega + 56\Omega$$

$$\Rightarrow R_{eq} = 29.87\Omega$$

$$I_2 = \frac{V_2}{R_{eq}} = \frac{5}{29.87}$$

$$\Rightarrow I'' = 0.17A \Rightarrow \left\{ I'' = 16mA \right\}$$

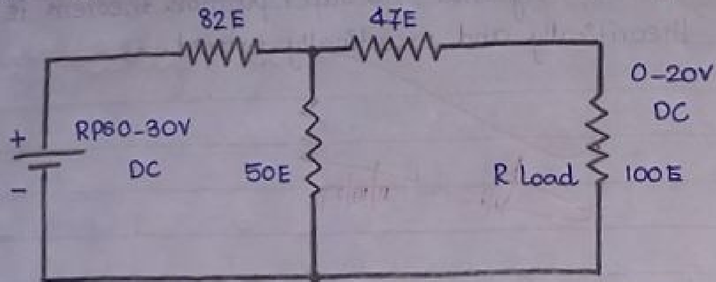
$$\therefore I = I' + I'' = 77 + 16$$

$$\therefore \left\{ I = 93\,mA \right\}$$

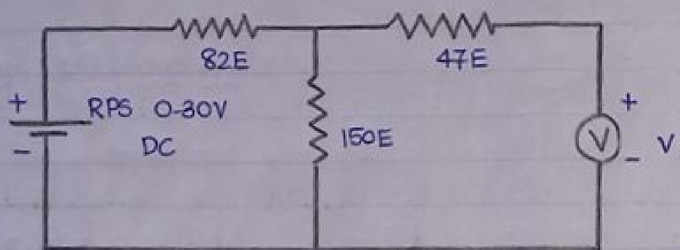
Result: We can say that the super position theorem is theoritically and practically proved.

11/10/23

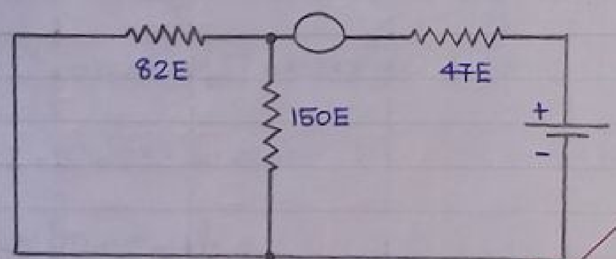
Circuit Diagram:



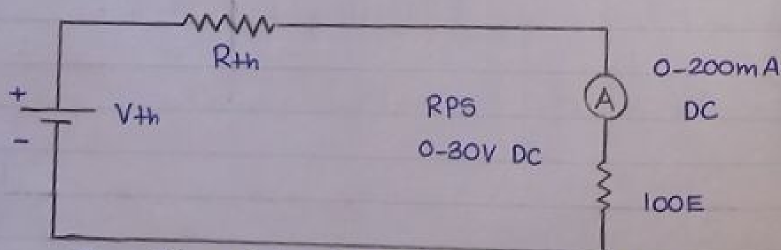
Linear Network (Measurement of I_L)



Linear Network (Measurement of Vth)



Measurement of Rth



Thevenin's equivalent circuit (Measurement of I_L)

Date : 11/10/23

Expiriment - 3(A) : Verification of thevenin's theorem

Aim: To Verify Thevenin's theorem theoritically and Practically

Statement: Any two terminal Active Linear network containing energy sources (generators) and resistance can be explained and replaced with equivalent circuit consisting of voltage source Vth in series with Resistance Rth. the value of Vth is open circuit voltage between the terminals of the network and Rth is Resistance measured between terminals with all energy sources eliminated. (but not thier internal Resistances)

Apparatus Required:

S.No.	Equipment	Range	Type	Quantity
1	Ammeter	(0-200)mA	DC	01
2	Voltmeter	(0-20) V	DC,	01
3	R.P.S	(0-30) V	DC	01
4	T. Theorem Kit	-	-	01
5	Resistors	82, 47, 100Ω	Fixed	04
6	Connecting wires	-	-	Required

Observation Table:

Table-1: Original Circuit

S.No.	Applied voltage (V)	Ammeter Reading I_L (mA)
1	6	25.3
2	12.1	52.2

Table-2: To find V_{th}

S.No.	Applied voltage (V)	I_L (mA)	V_{th}	R_{th}	R_L
1	6	25.8	3.87	100	47
2	12.1	52.2	7.86	100	47

Table-3: To find R_{th}

S.No.	V_{th}	(I) mA	R_{th}	R_L
1	3.87	25.3	100	47
2	7.86	52.4	100	47

Procedure:

* Connect the Series as shown in Figure 1
* Switch ON the supply and Apply 6V
* Note down the Reading of Ammeter as I_1
* Connect the circuit as Fig 2 and Apply 6V
* Note down the Reading of Ammeter(I) as V_{th}
* Connect the circuit as Fig 3 and Apply 6V
* Note down the Reading of Ammeter(I) & calculate R_{th} ($R_{th} = V/I$)
* Now connect the thevenin's equivalent as Fig 4 and Note down the Reading of Ammeter as I_1

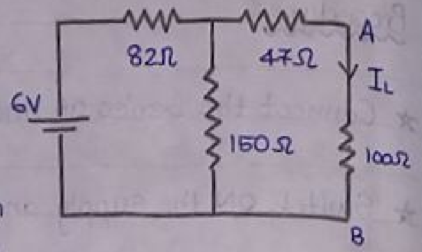
Precautions:

(i) Check for proper connections before switching ON the supply

(ii) Make sure of proper colour coding of resistors

(iii) Terminal of Resistance should be properly connected in series.

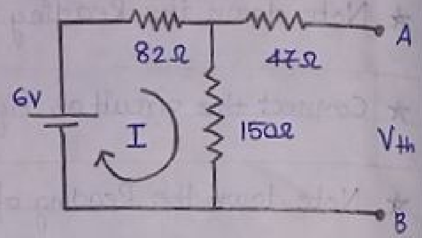
Theoritical Calculations :



(i) Remove 100Ω Resistor and find V_{th} between terminals A and B

No current flowing through 47Ω Resistor

$V_{th} = V_{AB}$ is thevenin's voltage between terminals then $R_{eq} = 150 + 82 = 232\,\Omega$



Current, $I = \frac{V}{R_{eq}} = \frac{6}{232} = 0.026A$

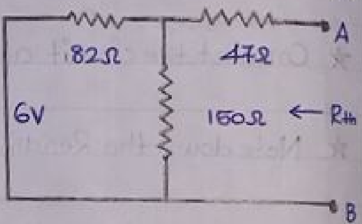
Voltage Across 150Ω $= I \times R$

$\Rightarrow 0.026 \times 150 = 3.9V \Rightarrow V_{th}$

(ii) To Find R_{th}

Reducing 6V voltage to zero, i.e short circulating space terminals

82Ω & 150Ω in parallel, then in series with 47Ω is $R_{th} = \frac{82 \times 150}{82 + 150} + 47$



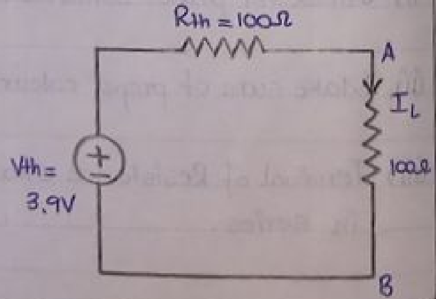
$\Rightarrow \frac{12300}{232} + 47 = 100\,\Omega$

Thevenin's Equivalent circuit and Reconnect Load Resistance

Load current, $I_L = \frac{V_{th}}{R_{th} + R_L}$

$= \frac{3.9}{100 + 100} = 0.0195\ A$

$\Rightarrow I_L = 0.0195A$ (or) $19.5\ mA$

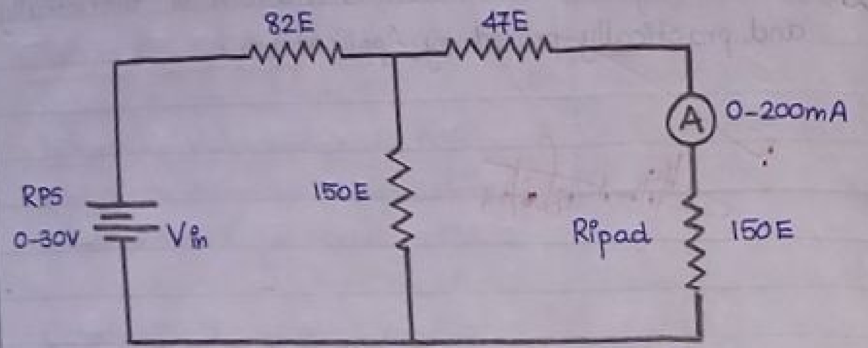


Date : 11|10|23

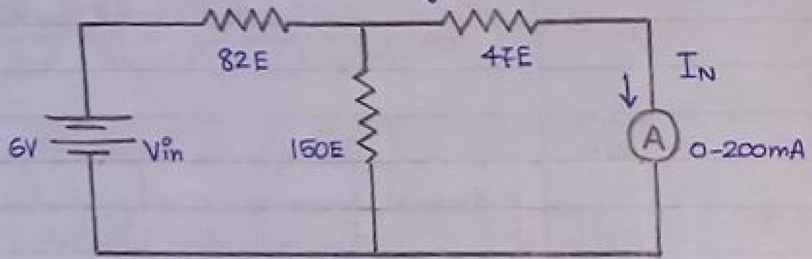
Result: We can say that the thevenin's theorem is theriotically and practically proved by Applications.

18/10/23

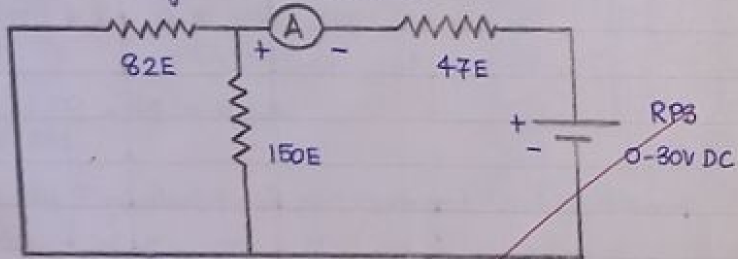
Circuit Diagram:



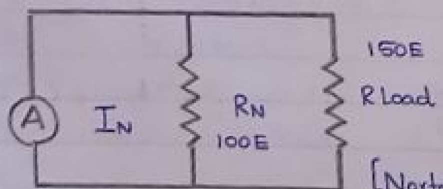
Linear Network [Finding Load current]



[Finding Norton's current]



[To Find Rs]



[Norton's Equivalent circuit]

Date: 18/10/23

Experiment-3(B): Verification of Norton's Theorem

Aim: To Verify Norton's theorem theoritically and Practically

Statement: Any 2 terminal linear Active Network Containing energy source (generators) and resistors can be replaced with equivalent circuit consisting of current source I_N in parallel with Resistance R_N. The value of I_N is short circuit between terminals of Network and R_N is the Resistance measured between terminals with all energy sources eliminated (but not thier internal Resistances).

Apparatus Required:

S.No.	Equipment	Range	Type	Quantity
1	Ammeter	(0-200)mA	MC	01
2	Voltmeter	(0-20) V	MC	01
3	R.P.S	(0-30)V	MC	01
4	Norton's theorem	-	-	01
5	Resistors	82,47,100	Fixed	04
6	Connecting wires	-	-	As Required

Observation Table :

Table -1: To Find R_N

S.No.	Applied voltage (V_{th})	I_L (mA)	I_N (mA)	R_L	R_N
1	5	14.5	32	120	100
2	10.6	30.5	67.6	120	100

Table-2 : Norton's Equivalent Circuit

S.No.	I_N (mA)	R_N (Ω)	I_L (mA)	R_L
1	32	100	14.5	120
2	67.6	100	30.2	120

Procedure:

★ Connect the circuit as shown in Fig. 1

★ Switch ON the supply and Apply 6V

★ Note down the Reading of Ammeter as I_1

★ Connect the circuit as shown and Apply 6V

★ Note down the Ammeter Reading as I_N

★ Connect the circuit as shown and Apply 6V

★ Note down the Reading of Ammeter as I and Calculate R_N where ($R_N = V/I$)

★ Now Connect Norton's Equivalent circuit as shown in figure and Note down reading of Ammeter as I_1

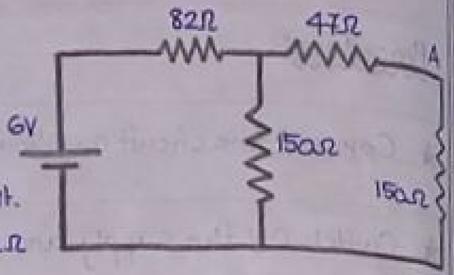
★ According to Norton's theorem, $I_1 = I_L$

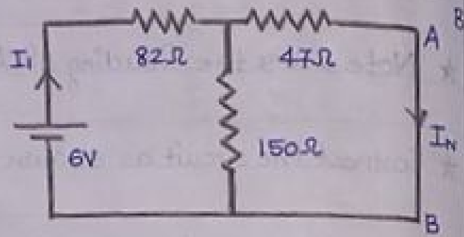
Precautions :

(i) Take care to connect Ammeter and voltmeter with thier correct polarity

Theoritical Calculations:

(i) To Find I_N: Disconnect the Load Resistance and place a short Across the terminals A & B. Find I_N through short. 47Ω & 150Ω are in parallel in series with 82Ω





$$\Rightarrow R_{eq} = \frac{47 \times 150}{47+150} + 82$$

$$\Rightarrow \frac{7050}{197} + 82 = 117.8\Omega$$

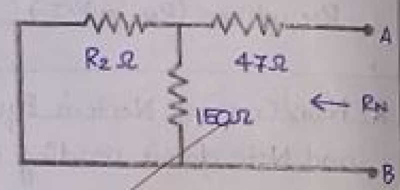
$$I_1 = \frac{V}{R_{eq}} = \frac{6}{117.8} = 0.509A$$

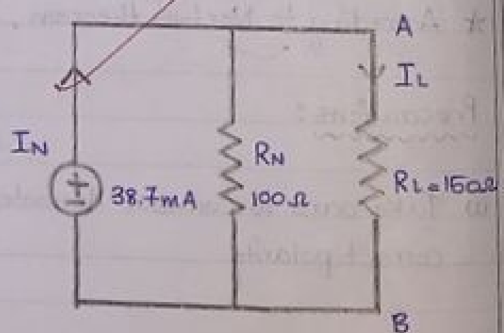
Apply CD Rule at point x then Norton's current be

$$I_N = I_1 \cdot \frac{150}{150+47} = 0.509 \times \frac{150}{197} = 0.0387 \Rightarrow \{I_N = 38.7mA\}$$

(ii) To Find R_N: Reducing voltage source to zero

Norton's equivalent circuit and Reconnect the Load Resistance





Load current, $I_L = I_N \cdot \frac{100}{100+150}$

$$= 38.7 \times 10^{-3} \times \frac{100}{250}$$

$$\Rightarrow I_L = 0.0155A \text{ (or) } 15.5mA$$

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(ii) Make sure of Proper colour coding of Resistors

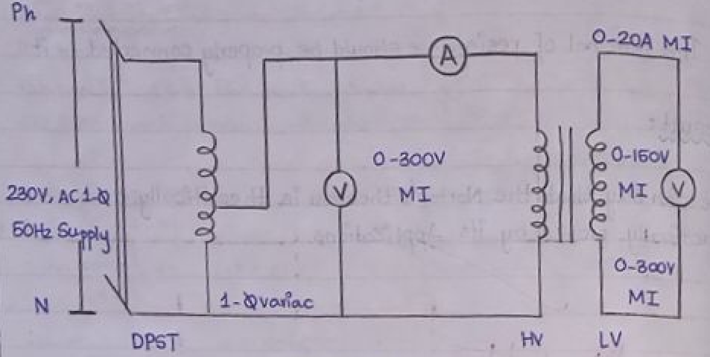
(iii) The Terminal of resistance should be properly connected to it

Result:

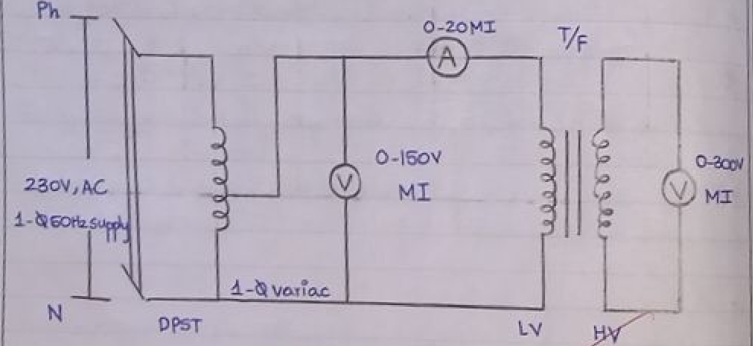
We can say that the Norton's theorem is theoritically and Practically proved by its Applications.

1/11/23

Circuit Diagram:



Circuit - I



Circuit - II

Experiment - 04: Determination of self mutual Inductances and Coefficient of coupling

Aim: To Determine Self inductance and Mutual inductance and coefficient of coupling of mutually coupled circuit.

Apparatus Required:

S.No.	Equipment	Range	Type	Quantity
1	Ammeter	0-20A	MI	01
2	Voltmeter	0-300V	MI	01
3	Single Phase transformer			01
4	Single Phase variac	0-300V	AC	01
5	Connecting wires	—	—	As Required

Theory: Self-Inductance:

Coefficient of self induction or self inductance (L) is ability of coil to induce emf in it due to change in its own current measured in Henry (H)

Self inductance of coil A, $L_1 = \frac{N_1 \phi_1}{I_1} \quad \frac{N_1^2}{[l/\mu_0 \mu_r a]}$

Self inductance of coil A, $L_2 = \frac{N_2 \phi_2}{I_2} \quad \frac{N_2^2}{[l/\mu_0 \mu_r a]}$

Theoritical Calculations:

For Circuit - I:

Input Impedance, $Z_1 = R_1 + J\omega L_1 = \frac{VI}{LI} = \frac{224}{0.13} \Rightarrow 1723.07$

Neglecting Resistance, then $\omega L_1 = \frac{V_1}{I_1} = \frac{224}{0.13} \Rightarrow 1723.07$

Self inductance of HV coil, $L_1 = \frac{V_1}{\omega L_1} = \frac{224}{314.16 \times 0.13} = 5.48H$

Mutual inductance $M_{12} = \frac{V_2}{\omega L_1} = 2.744$

For circuit - 2:

Input Impedance, $Z_2 = R_2 + J\omega L_2 = \frac{V_1}{I_1} = \frac{115}{0.29} = 396.55$

Neglecting Resistance, $\omega L_2 = \frac{V_1}{L_1} = 396.55$

Self inductance LV, $L_2 = \frac{V_1}{\omega L_1} = \frac{115}{314.16 \times 0.29} = 1.26$

Mutual inductance, $M_{21} = \frac{V_2}{\omega L_1} = \frac{229}{314.16 \times 0.29} = 2.61H$

$M = \frac{M_{12}+M_{21}}{2} = \frac{2.74+2.51}{2} = 2.625$

$\therefore$ Coefficient of coupling $K = M/\sqrt{L_1 L_2}$

$\Rightarrow \frac{2.625}{\sqrt{(5.48 \times 1.26)}} \Rightarrow \{K = 0.9989\}$

Mutual Inductance: May be defined as ability of one coil or circuit or inductance an emf is nearby coil by induction when current flowing in 1st coil is changed. the Action is also Reciprocal. the change in current flowing through 2nd coil will also induce an emf in 1st coil.

Coefficient of Mutual inductance $\Rightarrow M = \frac{N_2\phi_2}{I_1} = \frac{KN_1N_2I_1}{[l/\mu_0\mu_r a]I_1} = \frac{KN_1N_2}{[l/\mu_0\mu_r a]}$

Coefficient of Coupling: When 2 coils are placed near each other, flux produced by one coil does not link with other, certain portion of flux produced by one coil link with other coil, K being less than unity where $K = \frac{M}{\sqrt{L_1L_2}}$

Procedure for circuit - 1:

(1) Connect the circuit as shown in Fig. 1
(2) Keep the variac output voltage in minimum position
(3) Switch ON the supply
(4) Vary the variac till rated voltage is obtained on HV side
(5) Note down Readings of all meters

Procedure for circuit-2:

(1) Connect the circuit shown in Fig. 2
(2) Keep the variac output voltage in minimum position
(3) Switch ON the supply
(4) Vary the variac till Rated is obtained on LV side
(5) Note down the Readings of all meters.

Self Inductance of HV coil

$L_1 = \frac{W}{L_1} \Rightarrow WL_1 = \frac{V_1}{I_1} = \frac{224}{0.13} = 1723.07$

$L_1 = \frac{224}{314.16 \times 0.13} \Rightarrow 0.09$, Mutual inductance $\Rightarrow M_{12} = \frac{V_2}{\omega L_1} = \frac{112}{314.16 \times 0.13} = 0.046$

$\Rightarrow \omega L_1 \cdot \frac{V_1}{I_2} = \frac{115}{0.29} = 396.55$, $L_1 = \frac{115}{314.16 \times 0.29} \Rightarrow 0.106$

Mutual inductance $\Rightarrow M_{12} = \frac{V_2}{\omega I_1} = \frac{229}{314.16 \times 0.29} = 208.63$

Observation Table:

Circuit	I_1 (A)	V_1 (V)	V_2 (V)	Self inductance (L)	Mutual inductance (H)
Circuit-I	0.13	224	112.1	0.134	0.654
Circuit-II	0.29	115	229	0.294	0.577

Precautions:

(1) Connections should be made properly

(2) Always keep variac output voltage in minimum position

(3) Show connections to lab faculty

(4) Note down the Readings without parallax error

Result:

★ Self Inductance HV coil, $L_1 = 0.13$ H

★ Self Inductance LV coil, $L_2 = 1.26$

★ Mutual Inductance, $M_{12} = 2.61$

★ Mutual Inductance, $M_{21} = 0.0625$ H

★ Coefficient of Coupling $K = 0.9989$

∴ Self inductance and mutual inductance and coefficient of coupling of mutually coupled circuit is calculated.

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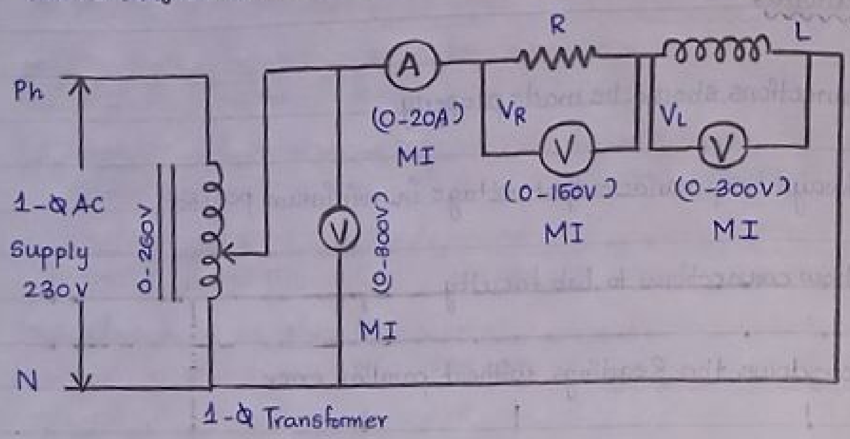
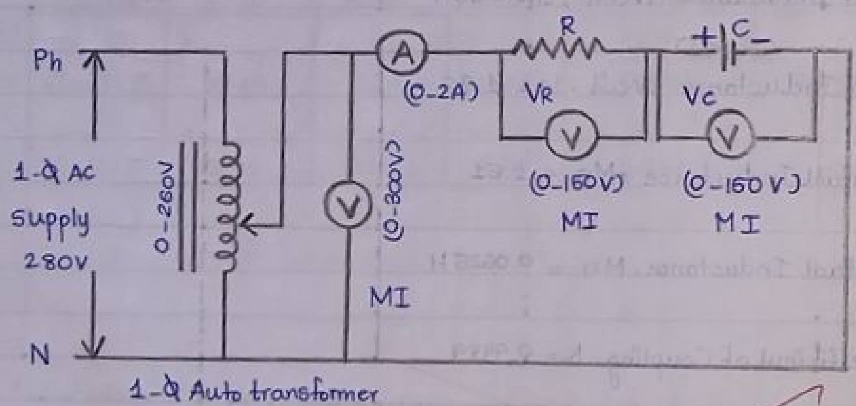
Circuit Diagram For Series R-L circuit



Circuit Diagram For Series R-C circuit



Date: 08|11|23

Experiment-05 : Sinusoidal Steady States Response of RL and RC Circuits

Aim: Calculating the impedance and current of RL, RC and RLC series circuits.

Apparatus Required:

S.No.	Name of Apparatus	Type	Range	Quantity
1	Voltmeter	MI	0-300V	3
2	Ammeter	MI	0-5A,0-2A	1
3	Resistor	WW	100ohm,5A	1
4	Inductor		150mA,5A	1
5	Capacitor		1μF	1
6	Singlephase variac	AC	3KVA,0-260V	1
7	Connecting wires			As Required

Theory: Passive components in AC circuits behaves very differently than with connected in DC circuit due to influence of frequency.

★ In Pure resistive circuit, the current is in phase with the voltage $\phi = 0$, $\cos\phi = 1$ (unity)

Theoritical Calculations of R-L circuit

$Z = \frac{V_S}{I} \Omega \Rightarrow \frac{9.7}{0.14} \Rightarrow 69.28\Omega$

$R = \frac{V_R}{I} \Omega \Rightarrow \frac{3.4}{0.14} \Rightarrow 24.28\Omega$

$X_L = \frac{V_L}{I} \Omega \Rightarrow \frac{8.19}{0.14} \Rightarrow 63.57\Omega$

P.f $\cos\phi = \frac{R}{Z} = \frac{24.28}{69.28} \Rightarrow 0.350$

$P = VI\cos\theta \Rightarrow 9.7 \times 0.14 \times 0.35 \Rightarrow \{P = 0.47\omega\}$

Theoritical Calculations of R-C circuit

$Z = \frac{V_S}{I} = \frac{10.0}{0.17} = 58.82\Omega$

$R = \frac{V_R}{I} = \frac{3.9}{8.17} = 22.94\Omega$

$X_C = \frac{V_C}{I} \Omega = \frac{8.9}{0.17} = 52.35\Omega$

P.f $\cos\phi = \frac{R}{Z} = \frac{22.94}{58.82} \Rightarrow 0.390$

$P = VI\cos\phi = 10.0 \times 0.17 \times 0.390 \Rightarrow \{P = 0.663\omega\}$

Date: 08|11|23

★ In Pure Inductive circuit, the current Lags the Applied voltage by 90 degrees, $\phi = 90$ and $\cos\phi = 0$ Lagging.

★ In Pure Capacitor circuit, the current Leads the Applied voltage by 90 degrees $\phi = 90$ and $\cos\phi = 0$ Leading

★ In series RL circuit, the current Lags applied voltage by angle ϕ, $0 < \phi < 90$ and $1 > \cos\phi > 0$ Lagging

★ In Series RC circuit, the current Leads Applied voltage by angle ϕ, $0 < \phi < 90$ and $1 > \cos\phi > 0$ Leading

★ In Series RLC, the current either Leads or lags or Lags the voltage by an angle ϕ
$0 < \phi < 90$ Lag or Lead, $1 > \cos\theta > 0$ Lag or Lead

Impedance of series R-L circuit, $Z = R + J\omega \Omega$

Impedance of series R-C circuit, $Z = R + J\Omega$

Impedance of series RLC circuit, $Z = R + J\Omega$

Impedance, $Z = \Omega$

Observation Table:

S.No.	V_S (V)	V_R (V)	V_L (V)	I (A)	$Z = V_S/I$	$R = V_R/I$	$X_L = V_L/I$	P.F	P.W
1	9.7	3.4	3.9	0.14	69.28	24.28	63.57	0.35	0.47
2	15.6	6.3	13.1	0.28	55.71	22.5	46.78	0.40	1.74
3	20.0	9.2	16.8	0.39	1.19	23.58	23.58	19.81	154.4
4	25.3	12.6	20.7	0.53	47.73	23.77	23.77	0.49	6.57

S.No.	V_S (V)	V_R (V)	V_C (V)	I (A)	$Z = V_S/I$	$R = V_R/I$	$X_C = V_C/I$	P.F	P.W
1	10.0	3.9	8.9	0.17	58.8	27.92	52.31	0.39	0.66
2	15.0	5.9	13.1	0.24	62.5	24.58	54.58	0.39	1.40
3	20.1	7.9	18.8	0.32	62.8	24.68	58.75	0.39	2.50
4	25.7	10.1	24.2	0.41	62.6	24.63	59.02	0.39	4.10

Date : 08/11/23

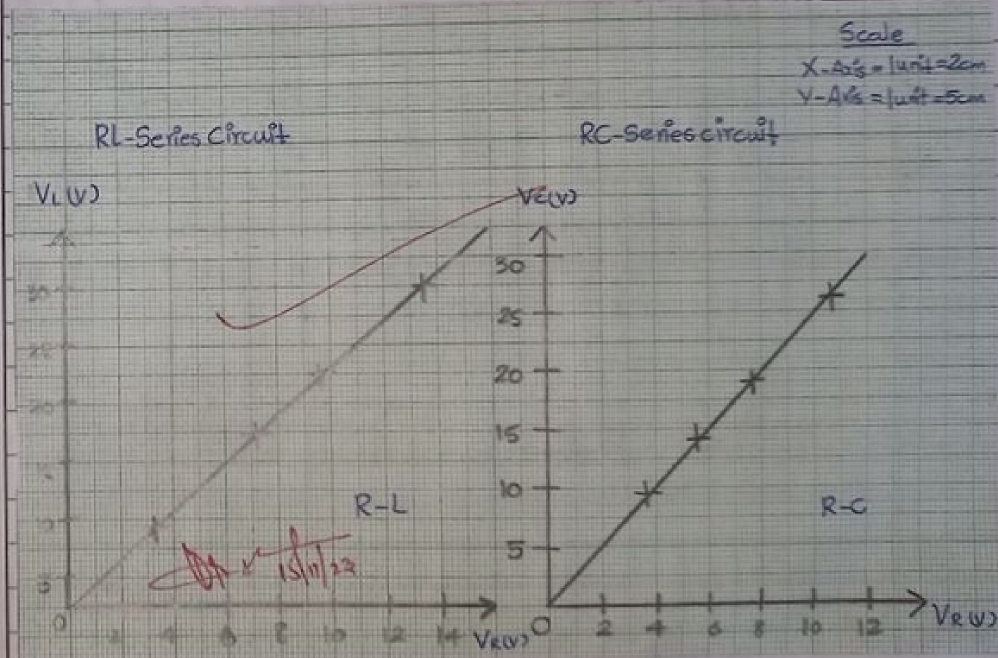
Precautions:

(1) Avoid Loose Connections

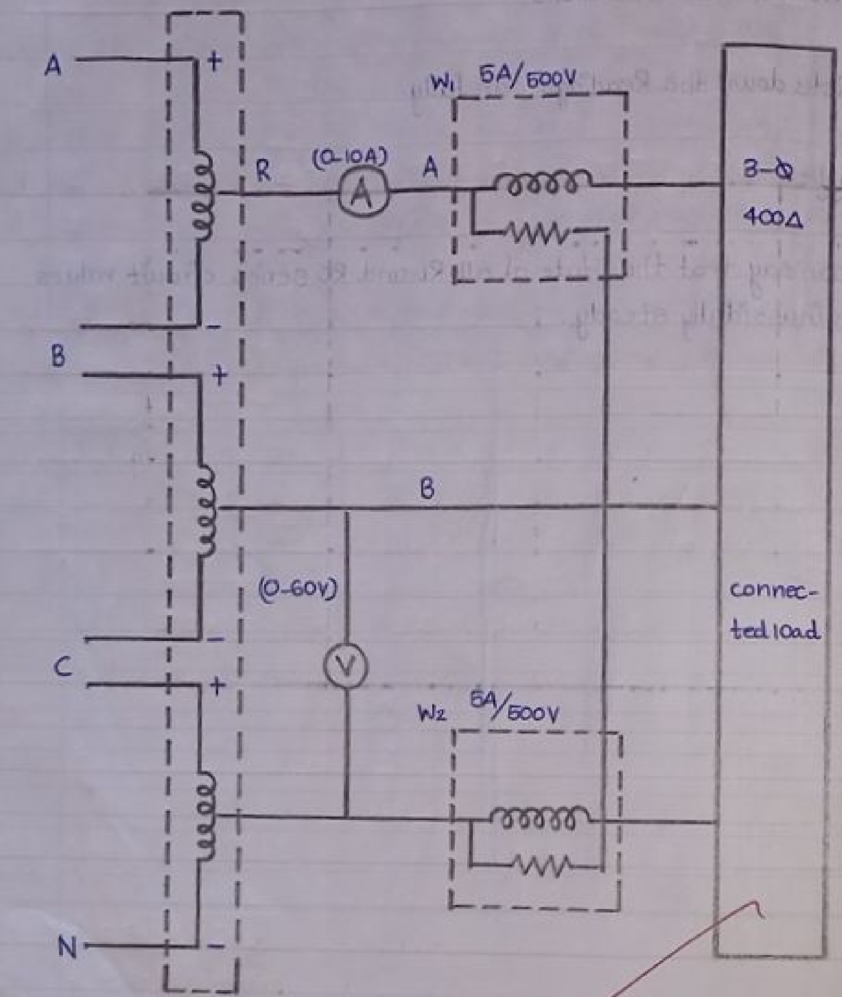
(2) Note down the Readings carefully

Result:

We can say that the state of all RL and RC series circuit values are sinusoidally steady.



Circuit Diagram :



Date : 15/11/23

Experiment-06 : Measurement of Phase voltage / Current, Line voltage / current and Power in a balanced three phase circuit connected in star and Delta.

Aim : To Measure the Active Power for Y-Δ connected balanced loads

Apparatus Required :

S. No.	Equipment	Range	Quantity
1	Digital voltmeter	(0-600V) MI	01
2	Ammeter	(0-10A) MI	01
3	Wattmeter	(0-600V, 5A)	01
4	R-Load Banks	(Y-Δ connect)	01
5	Connecting wires	—	

Procedure :

For Balanced Connected Loads :

(1) Make the connections as per circuit Diagram

(2) Connect the supply to Y-Δ Connected load through all meters as per circuit Diagram

Tabular Column:

R- Connection

S.No.	vol.(V)	I	W_1		W_2	
			obs	Act	obs	Act
1	395.2	1.53	0.5	500	0.5	500
2						
3						
4						

Δ-Connection

S.No.	Vol (V)	I	W_1		W_2	
			Obs	Act	obs	Act
1	392.8	4.57	1.6	1600	1.6	1600
2						
3						
4						

Calculations: Active Power (Y-connection) Star Load

$W_1 = 0.5 \times 100 = 500$

$W_2 = 0.5 \times 100 = 500$

Active Power in (Δ-connection) Delta Load

$W_1 = 1.6 \times 100 = 1600$

$W_2 = 1.6 \times 100 = 1600$

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(3) Switch ON the Main supply (M<B)

(4) Apply voltage using 3-φ dimmer Y (Star) upto 400V

(5) Take the Readings of wattmeter (W_1 and W_2)

(6) Repeat step and for Δ Connection Also

(7) Take the Readings of W_1 and W_2

(8) Switch OFF the Δ Connected series

Precautions:

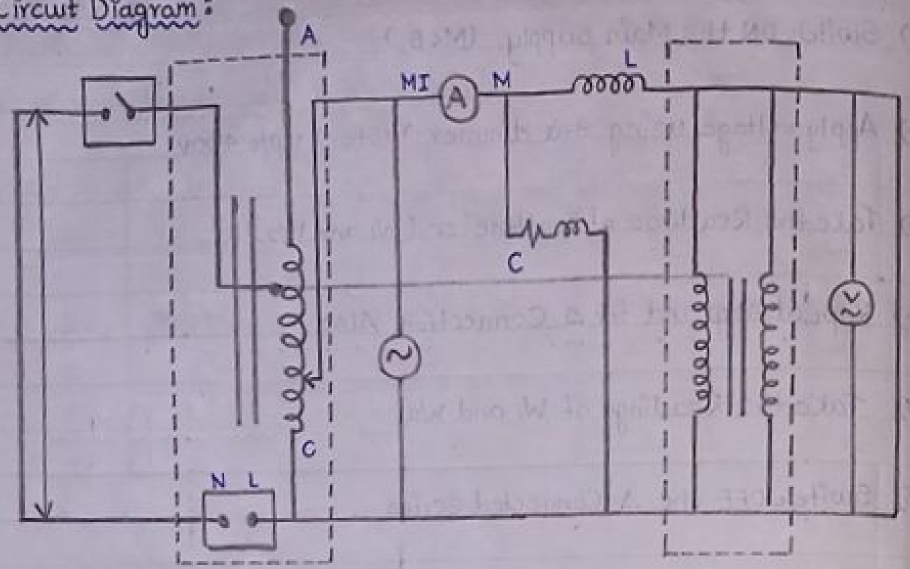
(1) Avoid loose Contacts

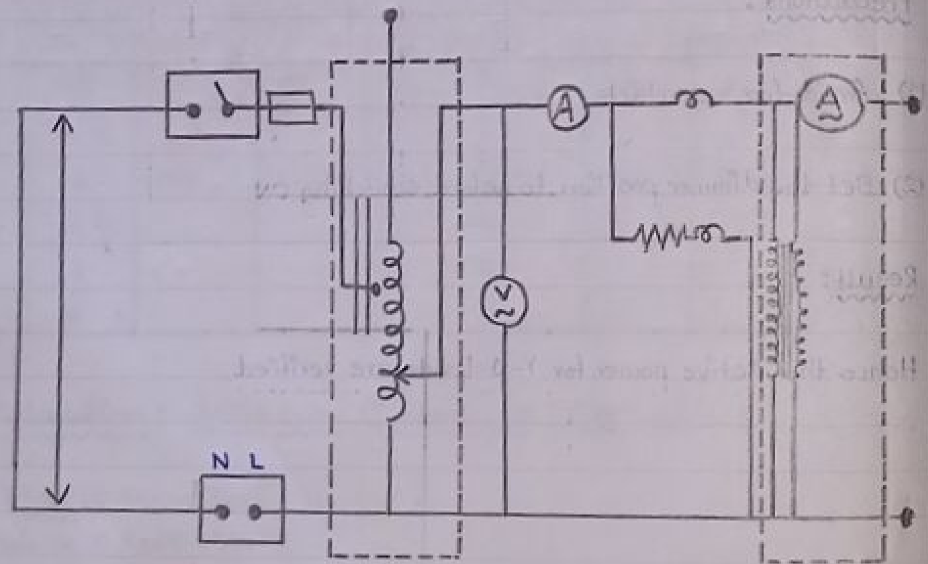
(2) Set the dimmer position to before switching ON

Result:

Hence the Active power for Y-Δ Loads are verified

Circuit Diagram:





Date: 13/12/23

Experiment - 07: OC and SC Test on Single Phase Transformer

Aim: To Obtain the Regulation and efficiency of a single phase transformer by conducting OC and SC test.

Transformer Specifications:

S.No.	Specifications	Rating
1	Transformer Rating	2KΩA
2	LV (in volts)	230V
3	LV (Side Current)	8.7A
4	HV (in volts)	440V
5	H Side Current	4.5A

Apparatus Required:

S.No.	Equipment	Type	Range	Quantity
1	Voltmeter	M:1	(0-150V) (0-60V)	2
2	Ammeter	M:1	(0-2A) (0-10A)	2
3	Wattmeter	Dynamo type	(0-130V) LPF	2
4	Wattmeter	Dynamo type	(0+60) VVPF	2
5	Connecting wires	–	–	Required

Calculations :

(1) Open Circuit test [OC test] :

S.No.	Open Circuit	Open Circuit	Power (W_{OC})		Secondary voltage
	Amps	volts	obs	Actual	
1	0.28	115.3	7.9	15.8	225.8

(2) Short Circuit test [SC test] :

S.No.	Primary Current	Primary Voltage	Power (W_{SC})		Secondary Current
	Amps	volts	obs	Actual	
1	0.214	8.3	25	50	4.27

Procedure For Circuit-1 {Open Circuit test}

(1) Connections are made as per circuit Diagram
(2) By Varying single phase variac, the input voltage to be applied on low voltage side of transformer.
(3) Now take down Readings of Ammeter, voltmeter and wattmeter.

Procedure For Circuit-2 {Short Circuit test}

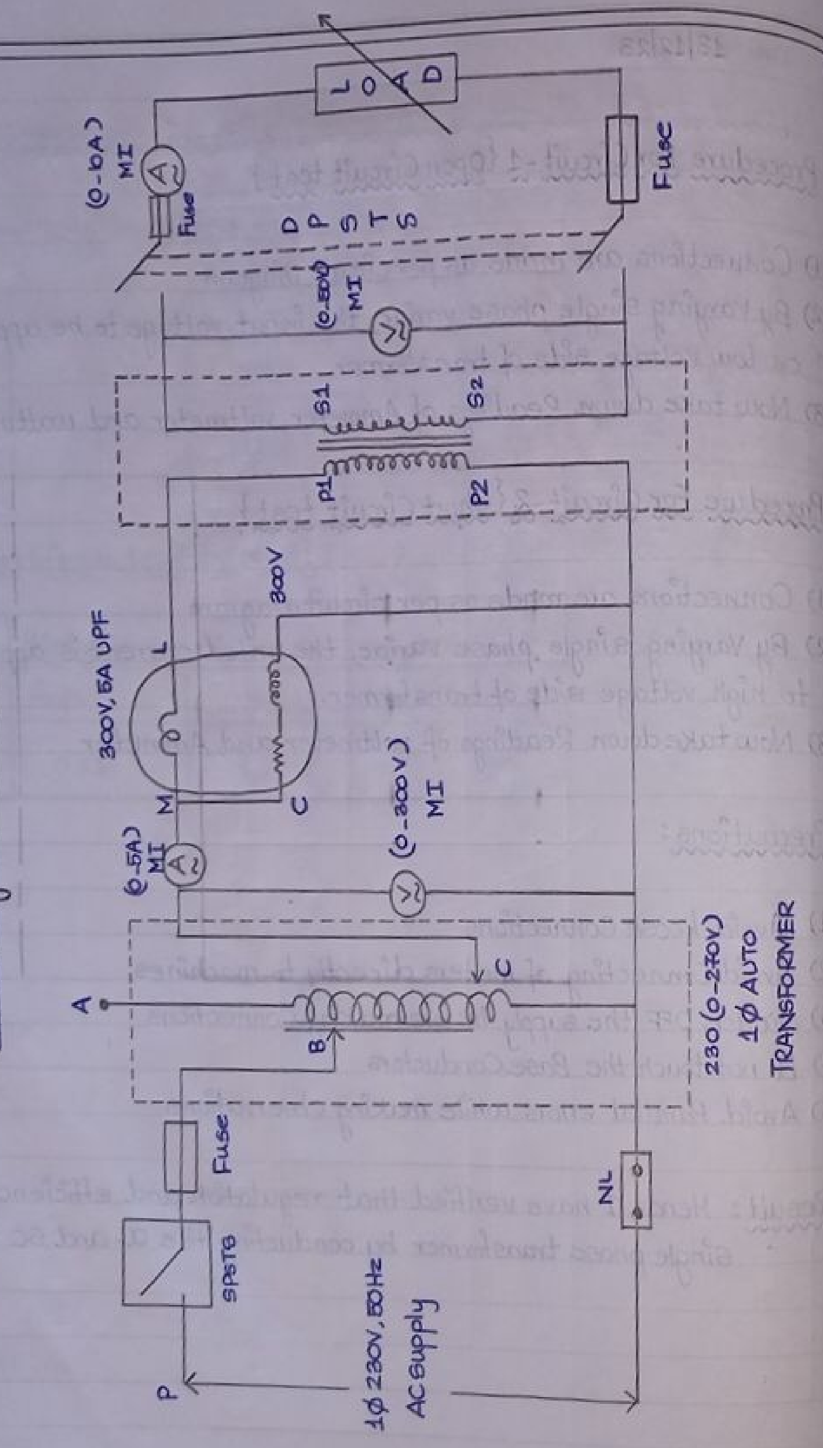
(1) Connections are made as per circuit diagram
(2) By Varying single phase variac, the rated current is applied to high voltage side of transformer.
(3) Now take down Readings of voltmeter and Ammeter

Precautions:

(1) Avoid loose Connections
(2) Avoid Connecting of meters directly to machines
(3) Switch OFF the supply before making Connections
(4) Do not touch the Base Conductors
(5) Avoid Parallal errors while making observations

Result: Hence, I have verified that regulation and efficiency of single phase transformer by conducting the OC and SC test

Circuit Diagram For Load Test on Single Phase Transformer



Date : 20/12/23

Experiment-08 : Loading of transformers : Measurement of the Primary & secondary voltages, current and Power

Aim: To load the transformer and measure voltage, current and power in primary and secondary sides.

Apparatus:

S.No.	Item	Type	Range	Quantity
1	Transformer	230/115V	500VA	1No.
2	Auto-transformer	Variable	0-230/27V	1No.
3	Voltmeter	Analog	0-300V	1.No.
4	Ammeter	Analog	0-10A, 0-20A	1 No.
5	Wattmeter	Analog	0-300V, 0-20	1No.

Procedure:

(1) Connect the circuit as per circuit diagram

(2) Slowly Apply the rated voltage on primary using the Auto transformer.

Tabulation For Load Resistance on Single Phase Transformer

S.No.	Primary volts	Primary current	Secondary voltage	Secondary current	Wattmeter		Input	Output	Effeciency	% of Regulation
	Volts	Amps	Volts	Amps	obs	Act	Watts	Watts	MP/IPx100	
1	229	0	114.8	0	0	0				
2	226	1.27	112	2.36	149	298				
3	226.3	2.40	109.3	4.63	270	540				

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(3) Note down the primary voltage, current and Power.

(4) Also Note down the Secondary voltage, current and Power.

(5) Verify the transformation ratio with voltage & current values

Precautions:

(1) Apply voltage Using Auto transformer slowly

(2) Note down reading without parallel errors.

Result: We can say that measurement of primary and the secondary powers are verified.