(Common for All Branches)

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Particulars of Experiments Performed

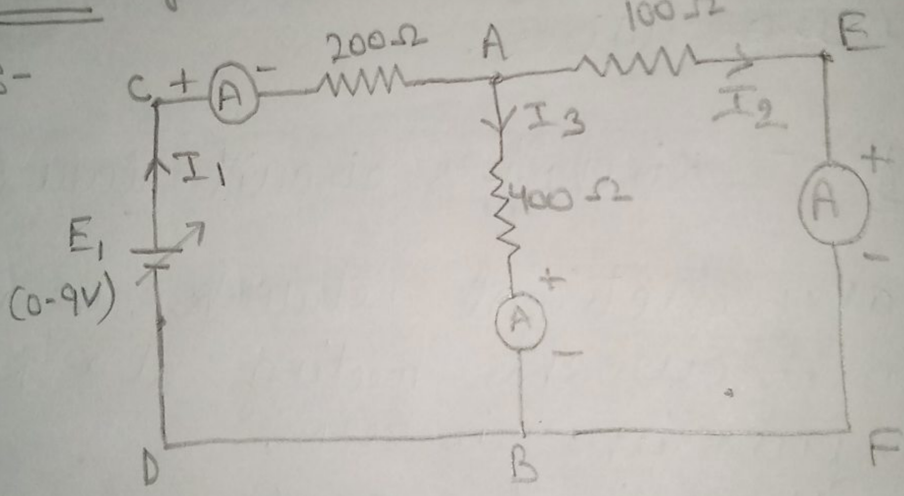
Experiment -1

Aim :- To verify Kirchoff's current law and voltage law.

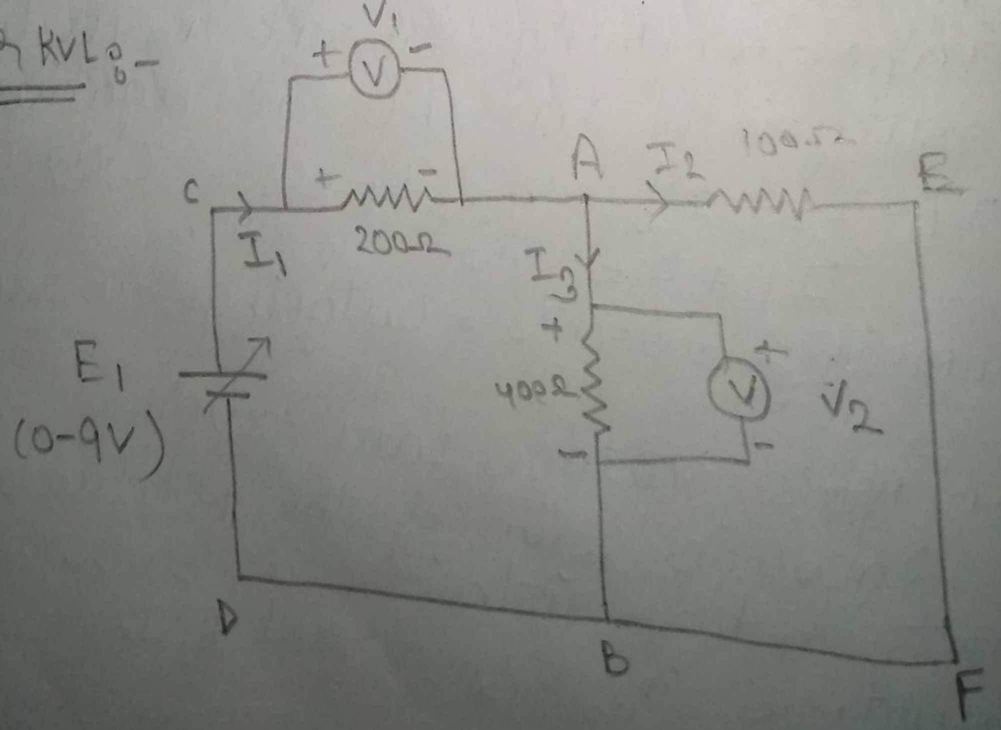
Apparatus :- DC supply (0-9V), voltmeter (0-9V), Ammeter (0-60A), Resistors (200 Ω, 100 Ω, 400 Ω), connecting wires.

Circuit Diagram :-

For KCL :-



For KVL :-



Experiment - 1

Aim :- To verify Kirchoff's current law and voltage law.

Apparatus Required :- DC supply (0-9V), voltmeter (0-9V), Ammeter (0-60 A), Resistors (200 Ω, 100 Ω, 400 Ω), connecting wires.

Theory :- Kirchoff's circuit law (KCL) ⇒

In any electrical network, the algebraic sum of current meeting at a point (or junction) is zero.

Mathematically $\Sigma I = 0$

Take incoming current as positive

outgoing current as negative

$I_1 - I_2 - I_3 - I_4 + I_5 = 0$ (fig ①)

$I_1 + I_5 = I_2 + I_3 + I_4$

Incoming current = outgoing current

Kirchoff's Voltage Law (KVL) ⇒

The algebraic sum of the products of the current and resistances in each of the conductors in any closed path in a observation table :-

For KCL

E_1	$I_1(mA)$	$I_2(mA)$	$I_3(mA)$	Error ⇒ $I_1 - (I_2+I_3)$
3V	7	6	1	0 mA
6V	20	16	3	1 mA
9V	22	17	4	1 mA

For KVL

E_1	V_1	V_2	Error ⇒ $E_1 - (V_1 + V_2)$
3V	2.14	0.86	0
6V	4.29	1.71	0
9V	6.43	2.57	0

Result :-

From the observations and calculations, KCL and KVL has been verified network plus the algebraic sum of Emf's in that part is zero.

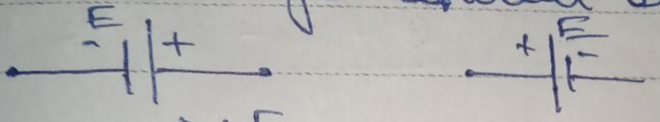
$\Rightarrow \Sigma IR + \Sigma emf = 0$

i.e. $E - I_1R_4 - I_1R_1 - I_1R_2 - I_1R_5 - I_1R_3 = 0$
(fig ②)

Sign conventions :-

a. Sign of Battery Emf

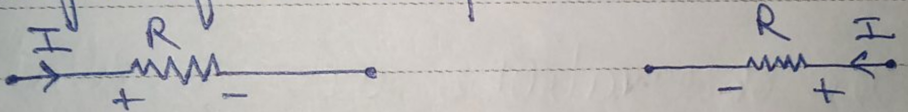
Rise in voltage should be given a +ve sign
Fall in voltage should be given a -ve sign



$\longrightarrow +E$ $\qquad$ $\longrightarrow -E$

Rise in voltage $\qquad$ Fall in voltage

b. Sign of IR drop



$\longrightarrow -IR$ $\qquad$ $\longrightarrow +IR$

Procedure :- For KVL ⇒

1. connect the circuit as shown in fig ③

2. First, set the input voltage supply to 3V and then connect each of the three resistors (200 Ω, 100 Ω and 400 Ω) one by one in series with the ammeter on

the kit.

3. Now, note the readings of ammeter with each of the resistors and name the current as I_1, I_2 and I_3.

4. Check that the readings of current should satisfy this equation $I_1 = I_2 + I_3$

5. Repeat steps 2, 3, 4 with 6V and 9V as input voltage supply.

6. Switch off the supply.

For KCL ⇒

1. Connect the circuit as shown in Fig (4) in the given kit.

2. First, set the voltage supply to 3V and connect each of the resistors (200Ω, 400Ω) one by one in parallel with voltmeter on the kit.

3. Now, note the readings of voltmeter with each of the resistors and name the obtained value of voltage

as V_1, V_2 respectively.

4. Find the error, if any, by the equation
$$E - (V_1 + V_2)$$

5. Now, repeat the steps 2, 3 and 4 with 6V and 9V as input voltage supply.

6. Switch off the supply.

Precautions :-
1. Check the zero settings of instruments before their use.

2. All connections should be tight.

3. Directions of current should be kept in mind.

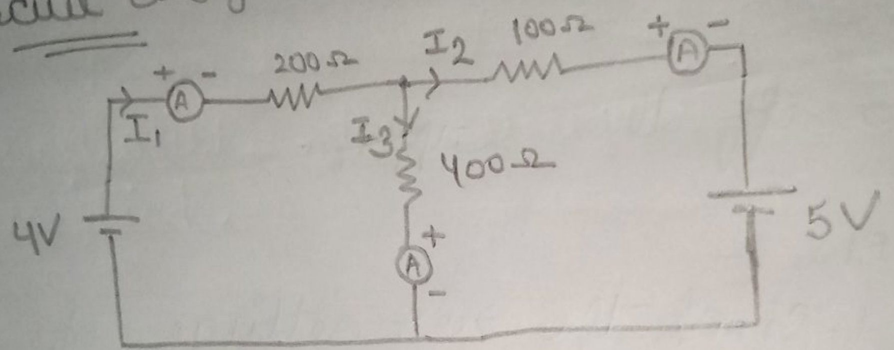
Result :- From the observations and calculations, both the KVL and KCL has been verified.

Experiment-2

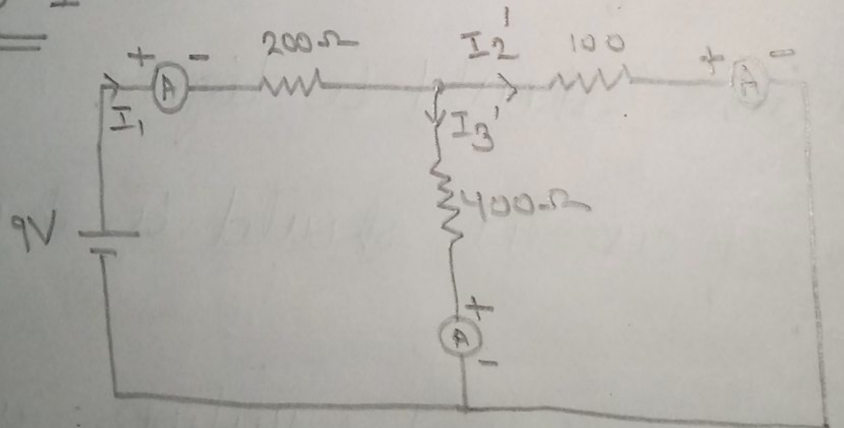
Aim:- To verify Superposition principle theorem

Apparatus Required:- DC supply (0-9V), voltmeter (0-9V), wires, Ammeter (0-60 A), Resistors (200 Ω, 100 Ω, 400 Ω)

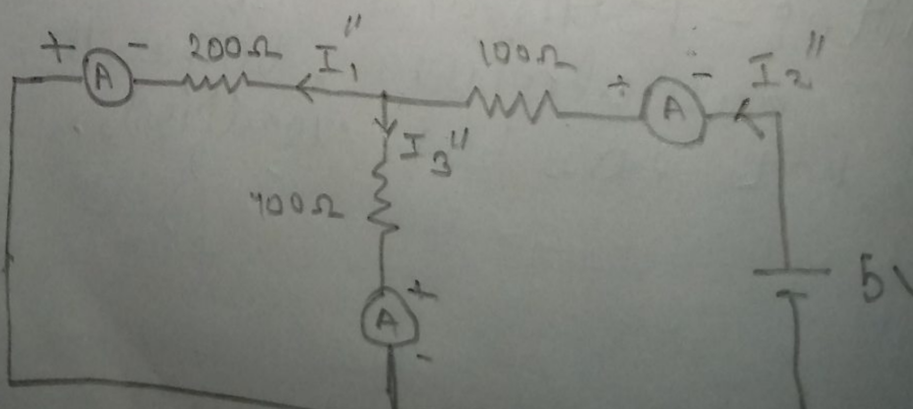
Circuit diagram:-



Step-I



Step-II



Dated

Experiment - 2

Aim:- To verify Superposition Principle or theorem

Apparatus Required:- DC supply (0-9V), voltmeter (0-9V), wires, Ammeter (0-60A), Resistors (200Ω, 100Ω, 400Ω)

Theory:- According to this theorem, if there are two or more than two sources of emf's acting simultaneously in a linear bilateral network, the current flowing through any section is the algebraic sum of all the currents which should flow in that section if each source of emf were considered seperately and all other sources are replaced by their initial resistance.

Procedure:-

1. Connect the circuit as shown in fig ①.
2. Now find the current through each resistor

Observation Table

Supply voltage	Current to mA			Error (mA)
	$I_1 = 20$	$I_1' = 32$	$I_1'' = 13$	$I_1 - (I' - I_1'') = 1$
	$I_2 = 7$	$I_2' = 26$	$I_2'' = 19$	$I_2 - (I_2' - I_2'') = 0$
	$I_3 = 13$	$I_3' = 7$	$I_3'' = 6$	$I_3 - (I_3' + I_3'') = 0$

Result :-

From the above observations and calculations, the superposition theorem is verified.

by connecting them one by one with the ammeter. From this, you will get values of I_1, I_2 and I_3.

3. For verifying superposition theorem, the first step we have to follow is to cut off 5V battery.

4. Then after short-circuiting 5V battery, find out the currents in the three resistors shown in fig ②, by connecting ammeter one by one with the three resistors.

5. Name these currents I_1', I_2', I_3'. Now repeats these steps by short-circuiting 2V battery and this will give value of I_1'', I_2'' and I_3''.

6. Now here, I_1 must be equal to $I_1' + I_1''$ and same with I_2 and I_3 and if not then there must be some error in your calculation or circuit.

Precautions:-

1. Direction of current should be correctly

identified.

2. Check zero setting of instruments before connection, rheostat terminals.

3. connections should be tight.

4. Ratings of currents to be kept in mind.

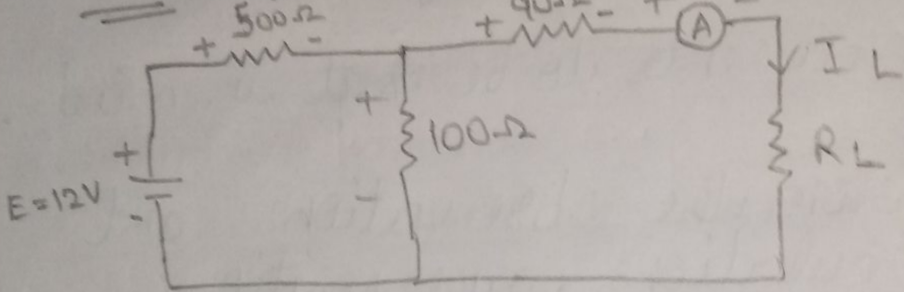
Result :- From the observations and calculations, superposition theorem has been verified.

Experiment-3

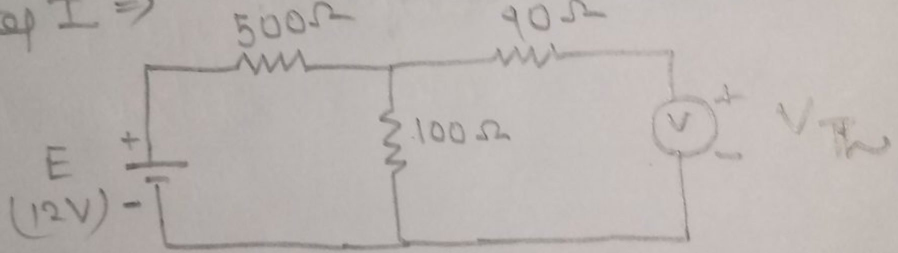
Aim:- To verify Thevenin's theorem

Apparatus:- DC supply, voltmeter, Ammeter, Resistors (500Ω, 100Ω, 90Ω)

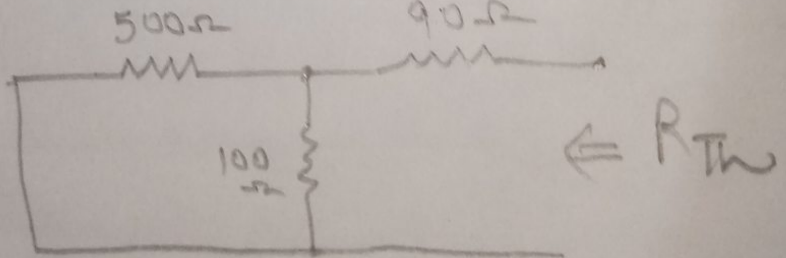
Circuit diagram:-



Step I ⇒

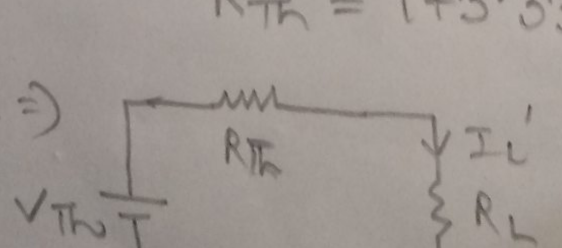


Step II ⇒



$R_{Th} = 173.33\,\Omega$

Step III ⇒



$$I_L' = \frac{V_{Th}}{R_{Th} + R_L}$$

Experiment - 3

Aim:- To verify Thevenin's theorem

Apparatus Required:- DC supply, voltmeter, Ammeter, resistor (500 Ω, 100 Ω, 90 Ω)

Theory:- The current flowing through a load resistance R_L connected across any two terminals A and B of a linear active bilateral network is given by $V_{oc} / (R_{Th} + R_L)$, where V_{oc} is open circuit voltage i.e. voltage across the two terminals when R_L is removed. R_{Th} is the internal resistance of network as viewed back into the open circuit network from terminals A and B with all voltages sources replaced by their internal resistance and current source by open circuit.

Procedure:-

1. Make the connections on the kit as shown in figure and switch on DC supply. This will give load current across different load resistance

Observation Table

$E(V)$	$R_L(\Omega)$	$I_L(mA)$	$V_{Th}(V)$	$R_{Th}(\Omega)$	$I_L'(mA)$	Error $(I_L - I_L')$
12	25	8	1.75	173.33	3.8	0.8 mA
12	50	7	1.75	173.33	7.8	0.8 mA
12	100	5.5	1.75	173.33	6.4	0.9 mA

Result :-

From the above calculations and observations, Thevenin's theorem is verified

Dated

connected by ammeter.

2. Now make the connections according to second figure i.e. open circuit load terminals and give 12V supply. This will give us open circuit voltage i.e. V_{Th}.

3. Make the calculation as shown in figure 3 and calculate R_{Th}.

4. Now we have V_{Th} and R_L, so with these values we can calculate I_L

$$\left(I_L = \frac{V_{OC}}{R_{Th} + R_L} \right)$$

Precautions :-

1. Meters should be used within proper range.
2. We must use neat and tight connections.
3. Zero setting of all meters should be checked before giving input supply.

Result :-

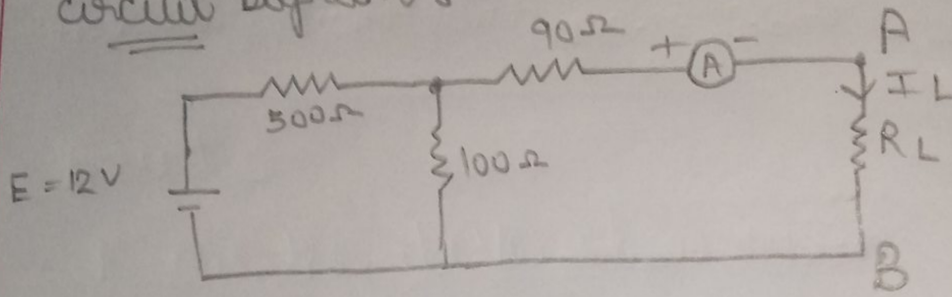
From the above observations and calculations, thevenin's theorem is satisfied / verified

Experiment - 4

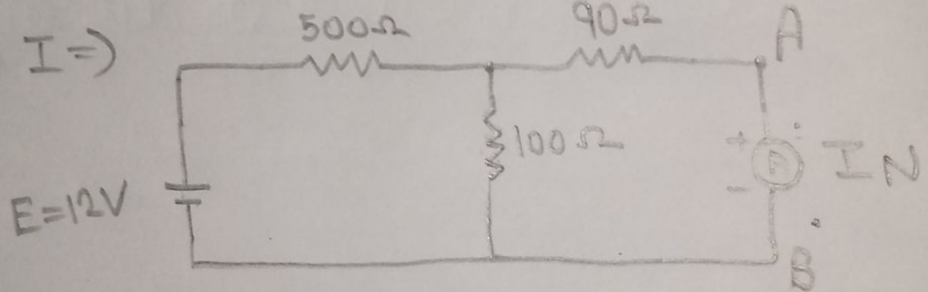
Aim:- To verify Norton's Theorem

Apparatus:- DC supply, voltmeter, ammeter, Resistance (500Ω, 90Ω, 100Ω)

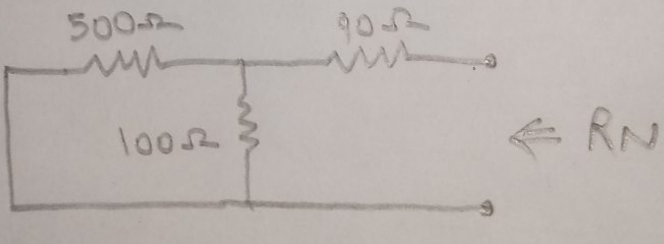
Circuit Digram :-



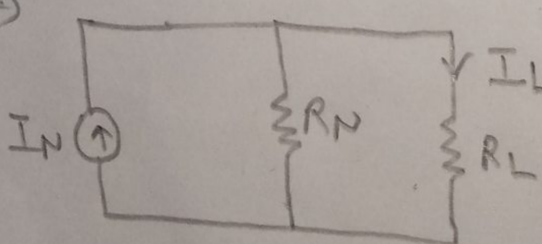
Step I =)



Step II =)



Step III =)



$$I_L' = \frac{R_N}{R_N + R_L} \times I_N$$

Dated

Experiment - 4

Aim:- To verify Norton's Theorem

Apparatus Required:- DC supply, voltmeter, ammeter, resistors (500Ω, 100Ω, 90Ω)

Theory:- The current flowing through a resistance connected across any two terminals of a network can be determined by replacing the whole networking by an equivalent circuit of a current source having a ~~cu~~ current output of I_N in parallel with resistance R_N, where I_N = short circuit current supplied by the source that would flow between the two selected terminals when they are short circuited.
R_N = equivalent resistance of the networks as seen from the two terminals with all other emf sources replaced by their internal resistance and current source replaced by open circuit.

Teacher's Signature.........................

Observation Table :-

E	R_L	I_L	I_N	R_N	I_L'	Error $=(I_L - I_L')$
12V	25Ω	8mA	10mA	173.33 Ω	7.7mA	0.7 mA
12V	50Ω	7mA	10mA	173.33 Ω	7.7mA	0.7 mA
12V	100Ω	5.5mA	10mA	173.33 Ω	6.3mA	0.9 mA

Result :-

From the above observations and calculations, Norton theorem has been verified

Dated

Procedure :-

1. Make the connections as shown in the circuit diagram and measure the value of current 'I_L' across 'R_L' with the help of ammeter at DC supply of 12V.

2. Now, by removing load resistance 'R_L', short the circuit across terminals AB in diagram ① and measure the value of short circuit current 'I_N' with the help of ammeter.

3. Calculate the equivalent resistance 'R_N' from the diagram ②

4. Hence find the value of current 'I_L' by using formula:

$$I_L = \frac{R_N}{R_N + R_L} \times I_N$$

Precautions :-

1. All the connections should be correct and tight.

Dated

2. zero setting of all meters should be checked before giving the input supply.

3. Readings should be noted carefully.

Result :-

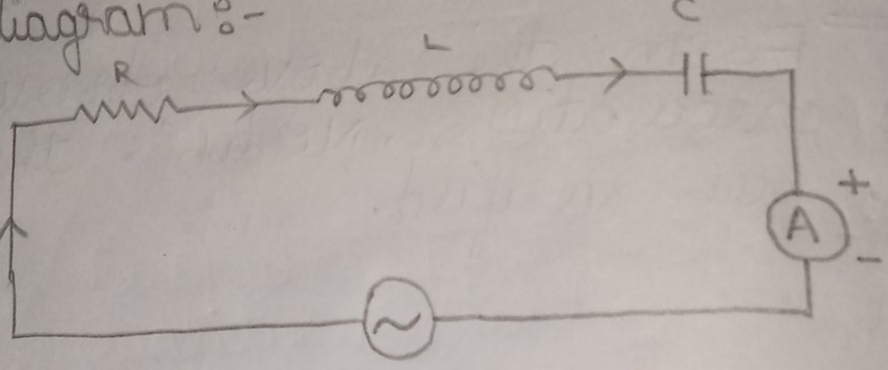
From the above observations and calculations, Norton's theorem has been verified.

Experiment -5

Aim:- To study frequency response of series RLC circuit and also calculate Q-Factor

Apparatus:- AC supply, voltmeter, Ammeter, Resistor, connecting wires.

Circuit diagram:-



Observation table:-

f (Hz)	I (mA)
1000	7.5
1500	8.5
2000	17
$f_R \leftarrow$ 2300	19.5
3000	13
4000	7
5000	5

$f_R = 2300 Hz$, $I_R = 19.5$ mA

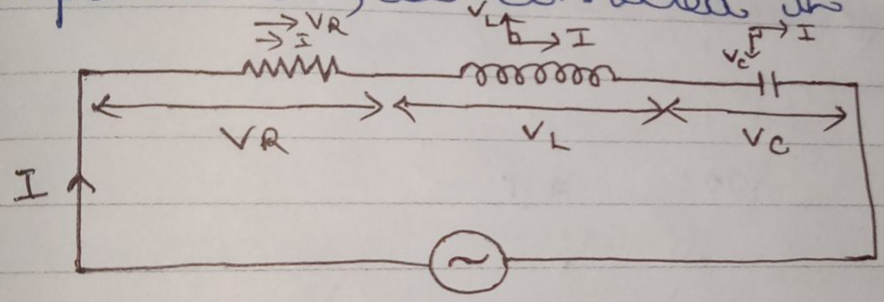
Dated

Experiment - 5

Aim:- To study frequency response of series RLC circuit and also calculate the quality factor.

Apparatus:- AC supply, voltmeter, Ammeter, Resistor, connecting wires.

Theory:- RLC series circuit ⇒
A circuit that contains pure resistance, pure inductance and pure capacitance, all connected in series.



$V_R = IR$ i.e. voltage across R is in phase with I

$V_L = I X_L$ (voltage across L leads I by $\pi/2$)

$V_C = I X_C$ (voltage across C lags I by $\pi/2$)

⇒ V_L and V_C are 180° out of phase with each other.

$V = \sqrt{V_R^2 + (V_L - V_C)^2} \Rightarrow \sqrt{(IR)^2 + (IX_L - IX_C)^2}$

$\Rightarrow V = I\sqrt{R^2 + (X_L - X_C)^2}$

Teacher's Signature..........................

Calculations :-

$R = 100\,\Omega$

$C = 0.2\,\mu F = 0.2 \times 10^{-6} F$

$L = 30\,mH = 30 \times 10^{-3} H$

Q-Factor $\Rightarrow \frac{1}{R}\sqrt{\frac{L}{C}}$

$\Rightarrow \frac{1}{100}\sqrt{\frac{30 \times 10^{-3}}{0.2 \times 10^{-6}}} = \sqrt{\frac{30}{2}}$

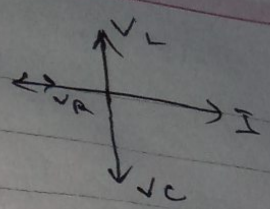
$\Rightarrow \sqrt{15} \Rightarrow 3.8729$

Result :- Resonance Frequency $= 2.3\,KHz$

Quality Factor $\Rightarrow 3.8789$

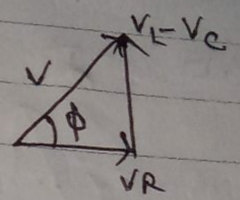
Dated

$$I = \frac{V}{\sqrt{R^2 + (X_L - X_C)^2}} = \frac{V}{Z}$$



$$\tan\phi = \frac{V_L - V_C}{V_R} = \frac{IX_L - IX_C}{IR}$$

$$\tan\phi = \frac{X_L - X_C}{R}$$

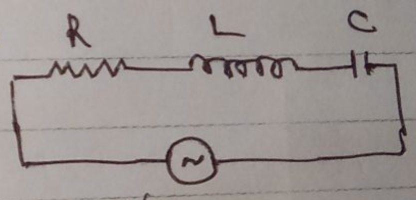


$$\phi = \tan^{-1}\left(\frac{X_L - X_C}{R}\right)$$

Series Resonance in RLC circuit (voltage resonance) ⇒

- In RLC series circuit, when circuit current is in phase with the applied voltage, circuit is said to be in series resonance.
- This condition is obtained in an RLC circuit when $X_L = X_C$

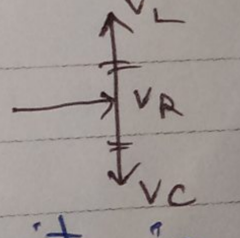
Impedance at Resonance



$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

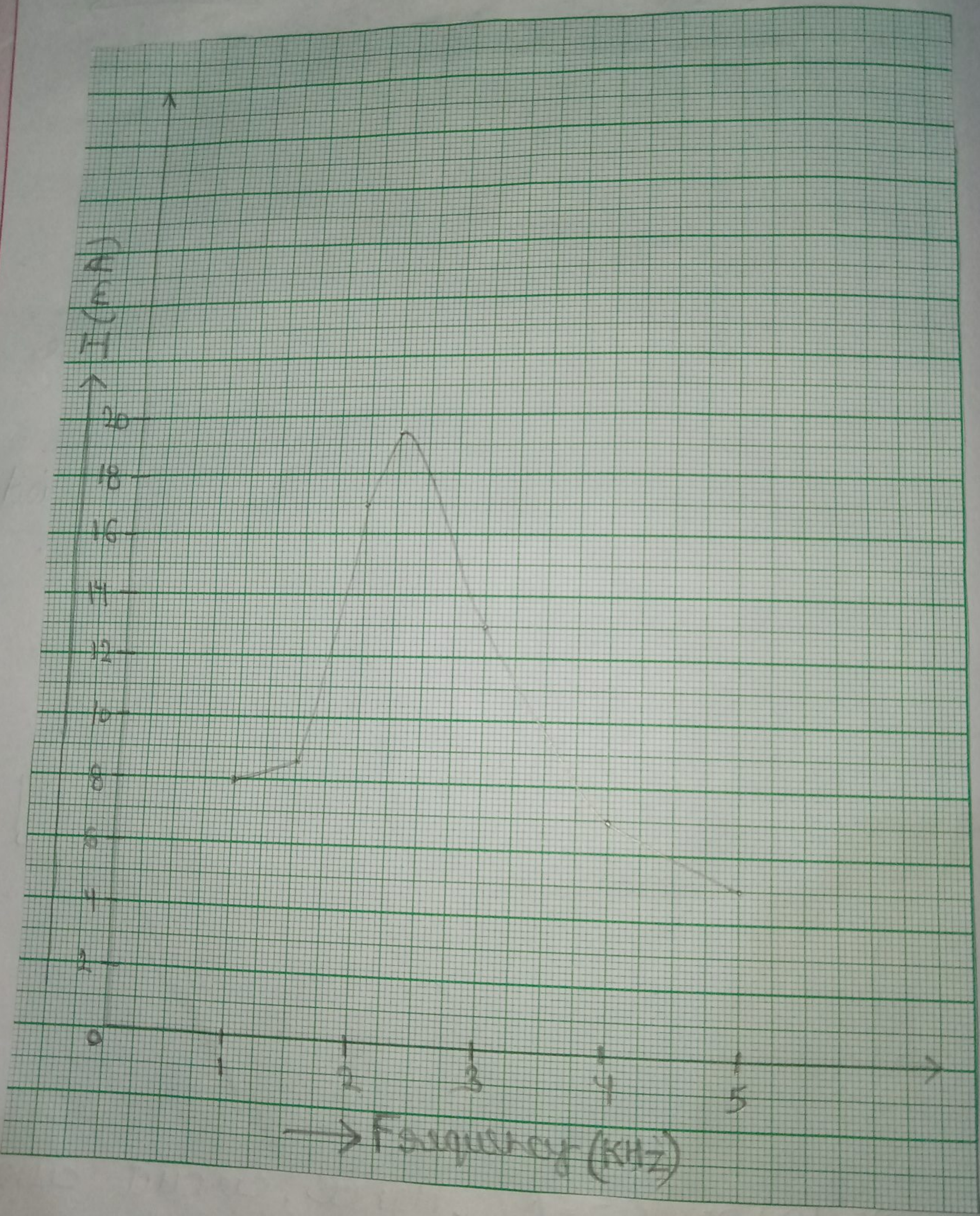
$$Z = R$$

current, $I_R = \frac{V}{R}$



- When a series RLC circuit is in resonance, it possess minimum impedance $(Z = R)$. Hence, circuit current is max.

Teacher's Signature..........................


20
18
16
14
12
10
8
6
4
2
0
1
2
3
4
5
Frequency (KHz)

Dated

Resonant Frequency ⇒ The frequency at which net resistance of the series circuit is zero.

$x_L - x_C = 0 \Rightarrow x_L = x_C$

$$2\pi f_r L = \frac{1}{2\pi f_r C}$$

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

Q-Factor of series Resonant circuit (Quality Factor) ⇒

It is given by voltage magnification produced in the circuit at resonance.

$$\text{Q-Factor} = \frac{\text{voltage across L or C}}{\text{Applied voltage}} \Rightarrow \frac{I_0 X_L}{I_0 R} \Rightarrow X_L / R$$

where, $\omega_0 = 2\pi f_0 \Rightarrow 1/\sqrt{LC}$

$$\text{Q-Factor} \Rightarrow \frac{L}{R} \times \frac{1}{\sqrt{LC}} \Rightarrow \frac{1}{R}\sqrt{\frac{L}{C}}$$

Procedure :-

1. Connect the circuit as shown in figure i.e. $R = 100\,\Omega$, $L = 30\,mH$, $C = 0.2\,\mu F$

2. Increase the frequency of signal upto

1KHz.

Dated

3. Find a point where current becomes maximum and then started decreasing by changing frequency. The frequency where current starts decreasing is known as resonance frequency.

4. Record the observations at different values of 'f' and find value of current.

5. Plot a graph between frequency vs current as shown

Precautions:-

1. All the connections should be correct and tight

2. Readings should be noted carefully.

3. Select appropriate value of inductor, resistor and capacitor for the experiment.

Result:- Resonance frequency = 2.3 KHz
Quality Factor ⇒ Q = 3.8789

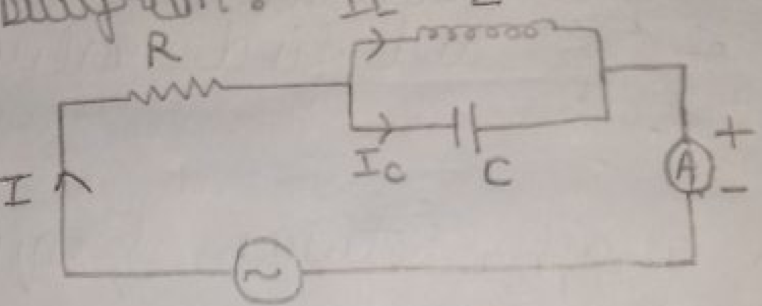
Teacher's Signature.........................

Experiment - 6

Aim :- To study the frequency response of parallel RLC circuit and also calculate quality Factor

Apparatus :- AC power supply, voltmeter, Ammeter, Resistor 150 Ω, Inductor (30 mH), capacitor (0.1 μF), connecting wires.

Circuit Diagram :-



observation Table :-

f(KHz)	I(mA)
1	11.5
1.5	10
2	6.5
2.5	1.5
f_R ← 3.1	0.5 → I_0
3.5	2
4	3
4.5	6.5
5	7.5

$f_R = 3.1$ KHz

$I_0 = 0.5$ mA

Dated

Experiment - 6

Aim :- To study the frequency response of parallel RLC circuit and also calculate Quality Factor.

Apparatus :- AC power supply, voltmeter, Ammeter, Resistor (50 Ω), Inductor (30 mH), capacitor (0.1 μF), connecting wires.

Theory :- Parallel Resonance (current Resonance) :-

- consider an inductor of 'L' henry having some resistance 'R' connected in parallel with a capacitor of capacitance 'C' across a supply voltage of 'V' volts.

- I_C will lead the voltage by 90°

- For resonance, the relative component of circuit current must be zero.

$I_C - I_L \sin \phi_L = 0$, $I_C = I_L \sin \phi_L$

where, $I_L = V / Z_L$, $\sin \phi_L = \frac{X_L}{Z_L}$

, $I_C = V / X_C$

Calculations :- $R = 50\,\Omega$

$C = 0.1\,\mu F = 0.1 \times 10^{-6}\,F$

$L = 30\,mH = 30 \times 10^{-3}$

Q-Factor $\Rightarrow \frac{1}{R}\sqrt{\frac{L}{C}}$

$$Q \Rightarrow \frac{1}{50}\sqrt{\frac{30 \times 10^{-3}}{0.1 \times 10^{-6}}} \Rightarrow 2\sqrt{30}$$

$$\Rightarrow 10.95$$

$$f_0 = \frac{1}{2\pi L}\sqrt{\frac{L}{C} - R^2}$$

$$f_0 = \frac{1}{2\pi \times 30 \times 10^{-3}}\sqrt{\frac{30 \times 10^{-3}}{0.1 \times 10^{-6}} - 2500}$$

$$f_0 = \frac{10^4}{60\pi}\sqrt{2975}$$

$$f_0 \Rightarrow 2.893\ KHz$$

Result :- Resonance Frequency = 3.1 KHz

Quality Factor = 10.95

$$\frac{V}{X_C} - \frac{V}{Z_L} \times \frac{X_L}{Z_L} = 0$$

$$(Z_L)^2 = X_L X_C$$

$$(Z_L)^2 = \frac{\omega L}{\omega C}$$

$$R^2 + X_L^2 = L/C$$

$$R^2 + (2\pi f_0 L)^2 = \frac{L}{C}$$

$$f_0 \Rightarrow \frac{1}{2\pi L}\sqrt{\frac{L}{C} - R^2}$$

where, f_0 = resonant frequency

- Current at Resonance :-

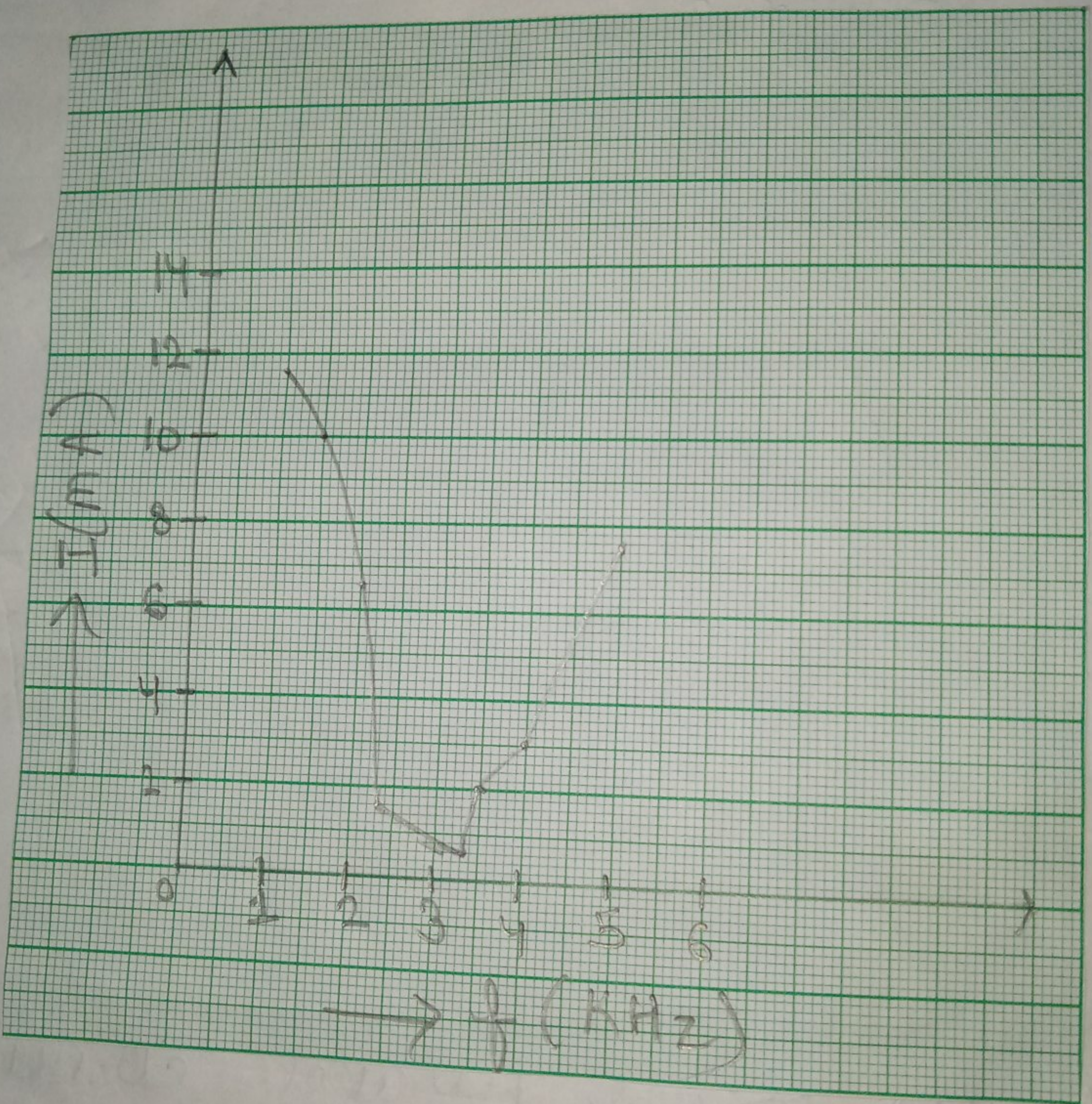
The circuit current is $I = I_L \cos\phi_L$
$= VR/(Z_L)^2$

putting the value of $(Z_L)^2 = L/C$

$$I = \frac{VR}{L/C} = \frac{V}{L/CR}$$

L/CR is known as equivalent/dynamic impedance of the parallel circuit at resonance.

Q-Factor of Parallel Resonance circuit :-
The ratio of current circulating between it's two branches is to the line current down from the



14
12
10
8
6
4
2
0
1
2
3
4
5
6
I (mA)
f (KHz)

Dated

supply.

Q-Factor = $\frac{\text{current circulating b/w L and C}}{\text{Line current}}$

$= I_c / I$

$I_c = \frac{V}{X_L} = \frac{V}{1/\omega C} \Rightarrow \omega C V$

and $I = V/(L/CR)$

Q-Factor $\Rightarrow \frac{\omega C V}{V/(L/CR)} \Rightarrow \frac{\omega L}{R} = \frac{2\pi f_0 L}{R}$

$f = \frac{1}{2\pi\sqrt{LC}}$

Q-Factor $= \frac{2\pi \times \frac{1}{2\pi\sqrt{LC}} \cdot L}{R}$

Q-Factor $= \frac{1}{R}\sqrt{\frac{L}{C}}$

Procedure :-

1. connect the circuit as shown in circuit diagram taking $R = 50\,\Omega$, $C = 0.1\,\mu F$, $L = 30\,mH$.

2. Increase the frequency of signal upto 1 KHz.

3. Find the point where current

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becomes minimum and then starts increasing by changing frequency. The frequency where current starts increasing is known as resonant frequency.

4. Record the observations at different values of 'f' and find value of current. Note down all the reading.

5. Plot a graph between frequency and current as shown.

Precautions:-

1. All the connections shown should be correct and tight

2. Readings should be noted carefully.

3. select appropriate values of inductor, resistor and capacitor for the experiment.

Result:- Resonance frequency = 3.1 KHz
Quality Factor = 10.95

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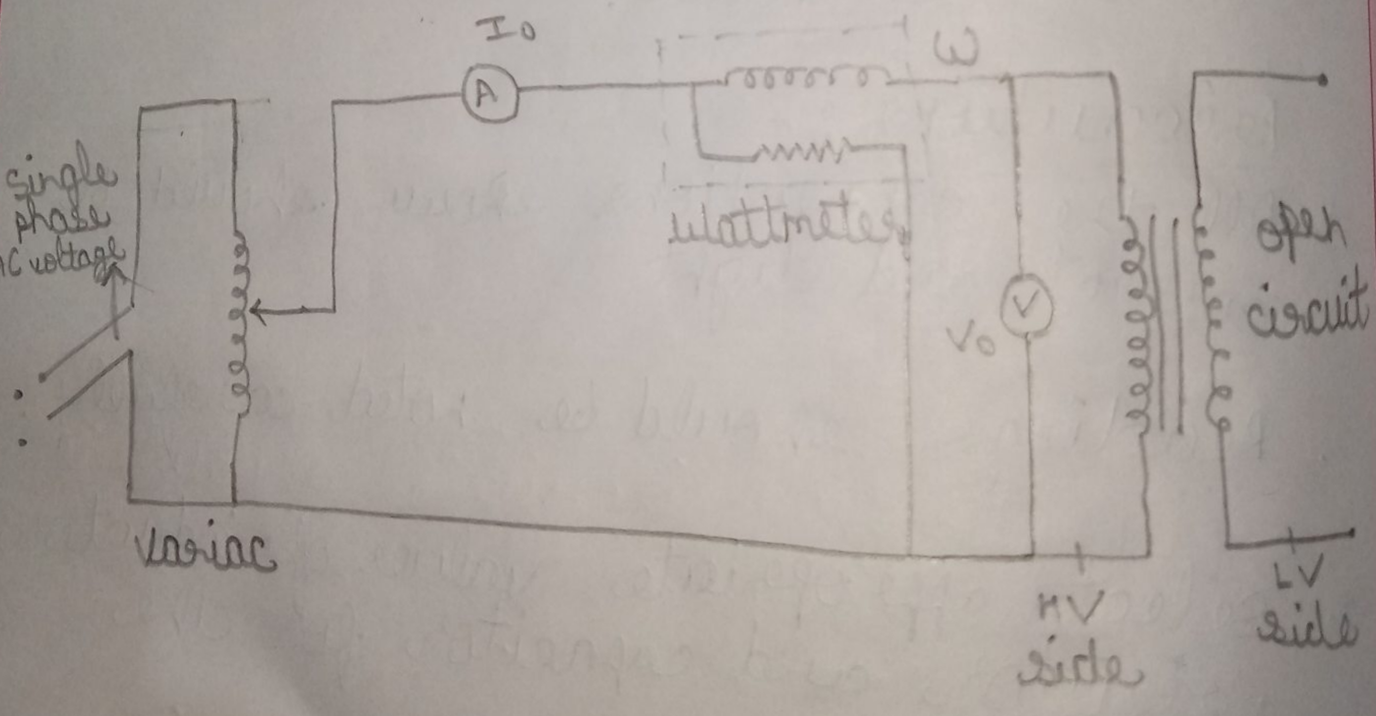
Experiment - 7

Aim:- To perform open test on single phase transformer.

Apparatus:- single phase transformer (1KVA 230/115 V)-01, single phase voltage variac (0-270V)-01, wattmeter (150 V, 5A)-01, voltmeter (0-30 V)-01, Ammeter (0-5A)-01, and connecting wires.

Circuit Diagram:-



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Experiment - 7

Aim:- To perform open circuit test on single phase transformer.

Apparatus:- Single phase transformer (1KVA 230/115V) - 01, Single phase, voltage variac (0-270V) - 01, wattmeter (150V, 5A) - 01, voltmeter (0-30V) - 01, Ammeter (0-5A) - 01, and connecting wires.

Theory:- Open circuit test (No load test) ⇒

The purpose of this test is to determine the core loss and no load current I_0, which is helpful in finding no load parameter R_0 and X_0 of transformer

- This test is carried out on low voltage side of the transformer, primary winding is connected to normal voltage V_L.

- Secondary is kept open circuited

- Since the secondary is open, the current

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Observation Table :-

S.No.	open circuit voltage V_0	open circuit current I_0	open circuit wattage W_0	$\cos\phi = \frac{W_0}{V_0 I_0}$	$I_M = I_0 \cos\phi$
1	230V	0.2A	15 W	0.326	0.652 A

$$I_M = \sqrt{I_0^2 - I_\omega^2} \Rightarrow 0.189\ A$$

Result :-

open circuit test has been performed

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drawn by the primary is no load current I_0 (2 to 10% of full rated current)

- copper loss is primary ~~is no~~ are negligibly small and there is no copper loss is secondary as it is open.

- Therefore, wattmeter reading represents core / iron loss.

let the wattmeter reading $= W_0$
voltmeter reading $= V_1$
Ammeter reading $= I_0$

Iron loss, $P_i = W_0$
$V_1 I_0 \cos\phi_0 = W_0$
No load power factor, $\cos\phi = \frac{W_0}{I_0 V_1}$

$$\cos\phi = \frac{W_0}{I_0 V_1}$$

Procedure :-

1. Make the connections as shown in circuit diagram.

Dated

2. check the primary winding should be at least low voltage.

3. Switch on the supply after setting zero input voltage with variac.

4. Adjust the primary voltage equal to rated voltage with the help of variac and record V_0, I_0 and W_0.

5. Keep the variac at zero position and switch off the supply.

Precautions :-

1. Ranges of different voltmeter, ammeter, wattmeter should be kept in mind.

2. Circuit should have tight connections.

Result :-

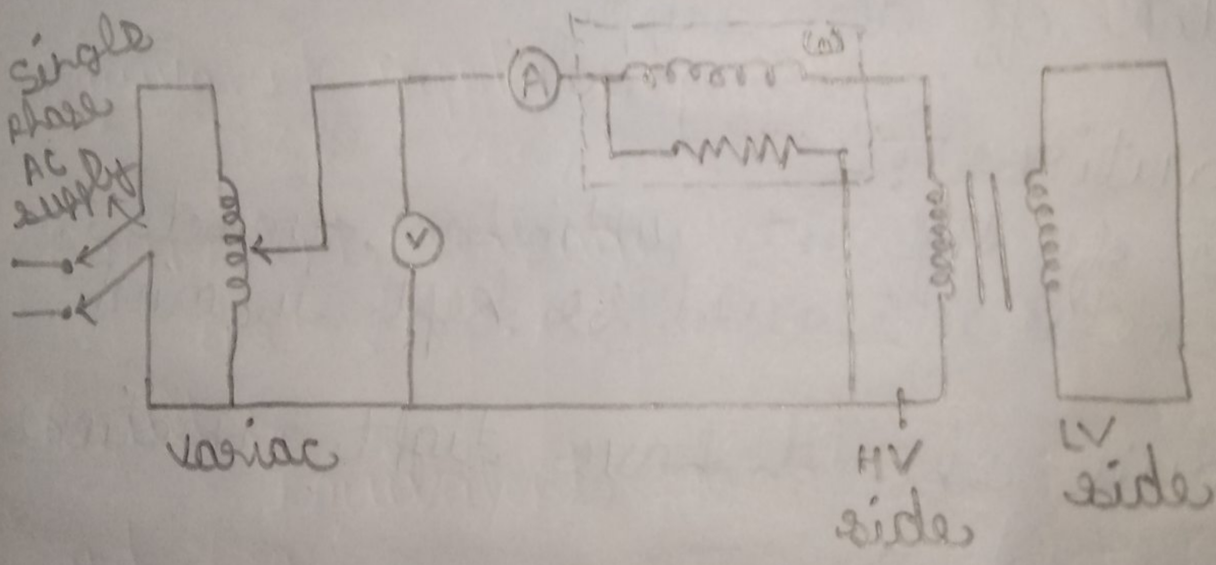
Open circuit test has been performed.

Experiment -8

Aim :- To perform short circuit test on single phase transformer.

Apparatus :- Single phase Transformer (1KVA / 230 / 115 V) -01, single phase voltage variac (0-270 V) -01, Wattmeter (150 V, 5A) -01, voltmeter (0-30V) -01, Ammeter (0-5A) -01, connecting wires.

Circuit Diagram :-



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Experiment - 8

Aim :- To perform short circuit test on single phase transformer.

Required Apparatus :- Single phase transformer (1KVA/230) -01, single phase voltage variac (0-270V) -01, Wattmeter (150V - 5A) -01, voltmeter (0-30 V) : -01, Ammeter (0-50 A) -01, connecting wires.

Theory :- The purpose of this ~~side~~ is to determine full load copper loss and equivalent resistance and reactance referred to mentoring side.

- Test is usually carried out on high voltage side of the transformer.

- Terminals of secondary winding (low voltage winding) are short circuited by thick wire.

- A low voltage (5 to 10%) of normal rated voltage is applied to the

Observation Table :-

S.No.	Short circuit current Isc	Short circuit voltage Vsc	Short circuit wattage Wsc	$Res = \frac{Wsc}{Isc^2}$ (Ω)	Zes (Ω) $\Rightarrow \frac{Vsc}{Isc}$	Xes (Ω) $\Rightarrow \sqrt{Zes^2 \cdot Res^2}$
1	1.9	10	15	4.1551	5.2631	3.2303
2	2.7	15	30	4.1152	5.5555	3.7321
3	3.7	20	45	3.2870	5.8823	4.87221

Calculations

Equivalent resistance required $\Rightarrow Res = \frac{Wsc}{Isc^2}$

$\Rightarrow 15/1.9 \Rightarrow 4.1551\ \Omega$

Equivalent Impedance Required

$\Rightarrow Zes = Vsc / Isc$

Equivalent leakage reactance $\Rightarrow$

$Xes = \sqrt{Zes^2 \cdot Res^2} \Rightarrow 3.2303\ \Omega$

Result :-

Equivalent parameters i.e. $Req = 4.1551\ \Omega$ and $Xeq = 3.2303$ were calculated along with copper loss.

Dated

transformer winding.
∴ flux set up in the core is also small and therefore iron losses are also small that there can be neglected.
. Hence wattmeter reading represent copper loss.

Procedure :-

1. connect the circuit as shown in fig.

2. set the variac at zero position.

3. switch on the supply.

4. Gradually increase the voltage by variac to make primary current equal to rated current.

5. Note down the readings of ammeter, voltmeter and wattmeter.

6. Keep the variac at zero position and switch off supply.

Dated

Precautions :-

1. All the connections should be tight and clean.

2. Special care should be taken while selecting the ranges of the meters for conducting short-circuit test.

3. While conducting the short-circuit test, the voltage applied should be initially set at zero, and then increase slowly. If a little higher voltage than the required voltage is applied, there is a danger of transformer being damaged.

Result :- Equivalent parameters i.e. Req and Xeq were calculated along with copper loss.

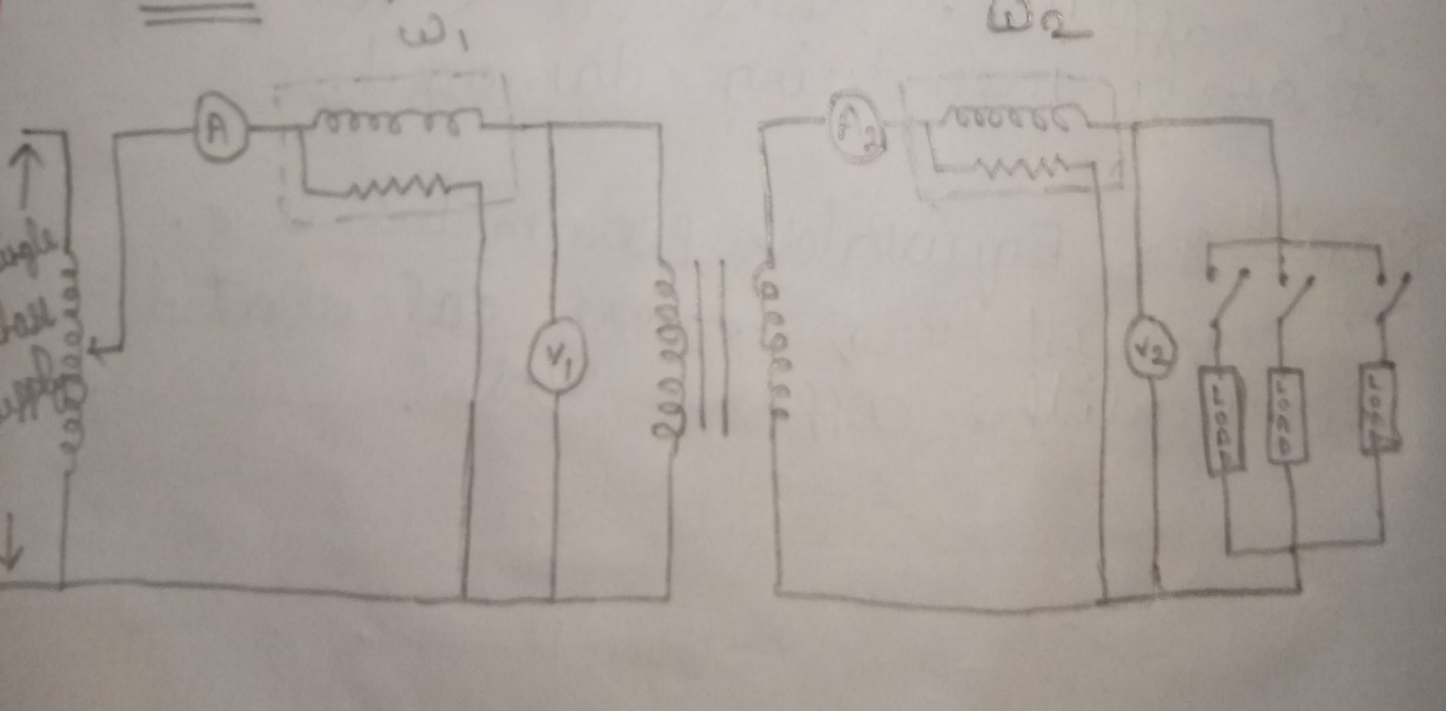
Experiment - 9

Aim:- To perform direct load test on a single phase transformer and plot graph b/w efficiency and load resistance.

Apparatus:-

1. single Phase Transformer (2KVa, 230/115V) - 1 no.
2. Auto transformer (0-270V) - 1 no.
3. Wattmeter (0-750 W) - 2 no.
4. Voltmeter (0-300V) - 2 no.
5. Ammeter (0-10A) - 2 no.
6. Resistive load and connecting wires

Circuit Diagram:-



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Experiment - 9

Aim:- To perform direct load test on a single phase transformer and plot graph b/w efficiency and load resistance.

Apparatus:- Single phase transformer (2K.V.A./115V) - 1, single phase voltage variac (Make B.R. Trading co.) (0-270V) - 1, wattmeter (0-750 W, 5A/300V) (Make: Larko) - 2 no's, voltmeter (0-300) - 2, ammeter (0-10 A) - 2, resistive load and connecting wires.

Theory:- Input to the transformer is observed with the help of the wattmeter, let it be W_1. The output of the transformer is calculated from the product of the voltage, V_2 and current I_2 in the secondary of the transformer and from wattmeter reading W_2. The load is taken as resistive load only and therefore has the power factor of unity.

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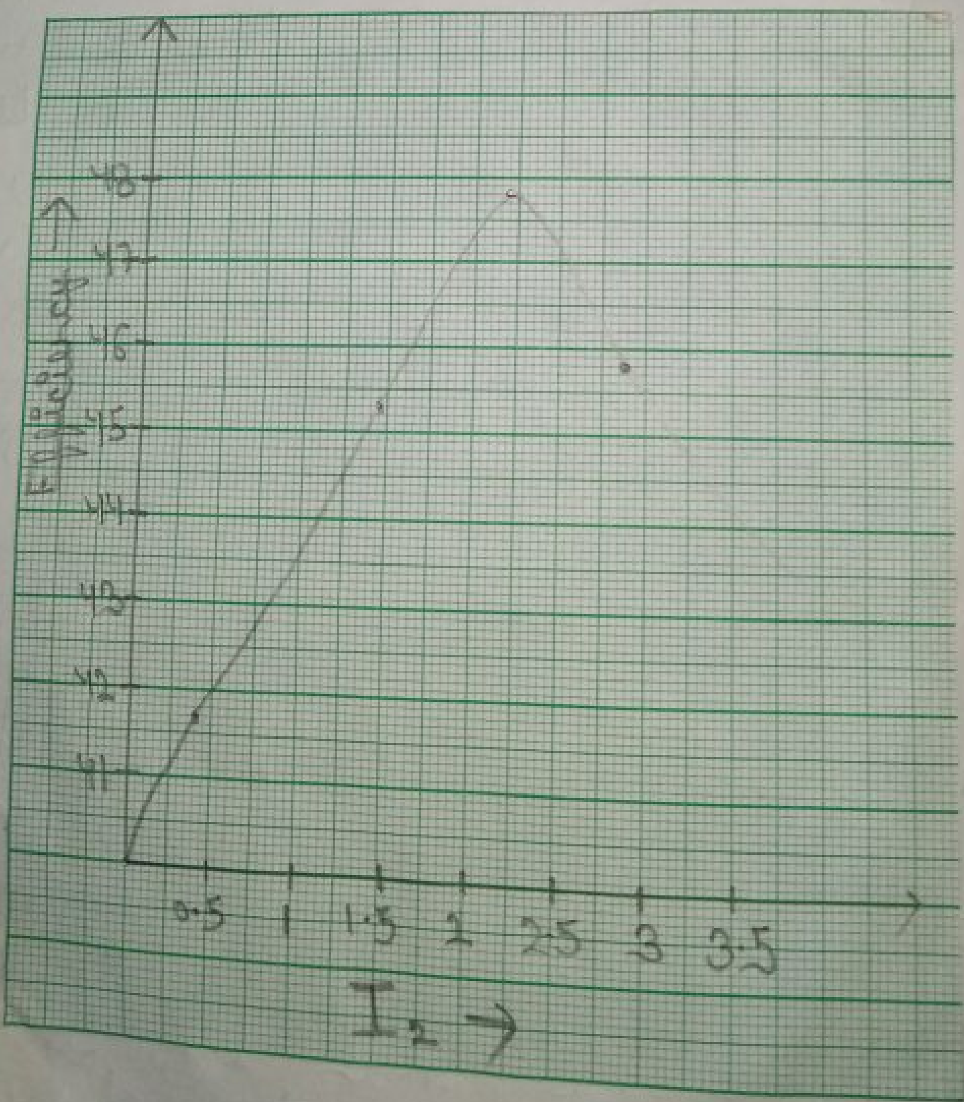
Observation Table :-

Input voltage V_1	Input current I_1	Input Power P_1	output voltage V_2	output current I_2	output Power P_2	% efficiency $\Rightarrow \frac{P_2}{P_1} \times 100$
220V	0.6A	180W	215V	0.4A	75W	41.6
220V	1.5A	345W	210V	1.4A	165W	45.3
220V	2.3A	510W	205V	2.2A	225W	47.8
220V	2.8A	645W	200V	2.9A	300W	45.8



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So we can write,
% efficiency of transformer
$\Rightarrow \frac{\text{output}}{\text{input}} \times 100 \Rightarrow \frac{W_2}{W_1} \times 100$

Procedure :-

1. Connect the circuit as per circuit diagram.

2. Ensure that there is no load on secondary winding of transformer.

3. Switch on the AC supply and record no load voltage across the secondary windings.

4. Adjust approx 10% of full load current in load and record the readings of all meters.

5. Repeat the above for various load currents till the full load.

6. Reduce the load.

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Result :- When the load current is increasing, efficiency is increasing

Dated

7. Switch off the supply.

Precautions :-

1. The connections should be tight.
2. Readings should be taken carefully.
3. Voltmeter and ammeter should be of proper range.
4. Handle the instrument carefully.

Result :-

When the load current is increasing, efficiency is increasing.