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LABORATORY MANUAL

Circuit &Simulation Lab

(3rdSemester)

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TABLEOFCONTENTS

EXPERIMENT NO-01

AIMOFTHEEXPERIMENT:-Measurement of equivalent resistance in series and parallel circuit.

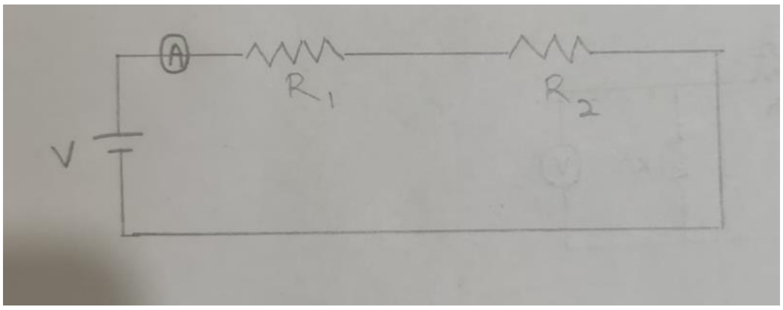
COMPONENTREQUIRED:-

Sl.No	NameoftheComponents	Specification	Quantity
1	Trainer kit		
2	Ammeter		
3	Voltmeter		
4	Patch cord		

THEORY:

SERIES CIRCUIT

When a number of resistors are connected in such a way that the head of one is connected to the tail of other ie end to end connection then the resistors are said to be connected in series. In series connection of resistors the current remains the same across each resistor while the voltage across each resistor is different. The equivalent resistance (Req) of a series connection of resistors is given by- **Req=** $R_1 + R_2 + R_3 + \ldots\ldots\ldots R_n$



PROCEDURE:-

SERIES CIRCUIT

1. Connect AC Supply to the kit .
2. Connect resistor R_1 in series with resistor R_2.i.e connect T_{16} to T_{17}.
3. Connect 0 to 15 v variable DC supply-1(0 to 15) +ve of current meter and GND toT_{19}.
4. Connect -ve of DC circuit meter to T_{13} of resistance block.
5. Connect +ve terminal of DC voltmeter to (0 to 15) of variable DC supply-1 and -ve to ground.
6. Switch on the power supply.
7. Change the power supply voltage by using Dot P1 as shown in table.
8. Observe the corresponding current on Ammeter.
9. You can further connect more resistance in series. To do so remove connection of T_{19}& ground connect T_{19} to T_{21} and ground to T_{23} .
10. Measure the current and voltage and note down the reading.

OBSERVATION TABLE:-

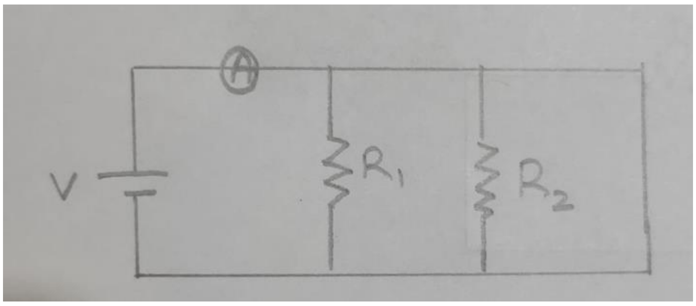
Voltage	When R= R1+R2=2KΩ	
V (Volt)	Theoretical current	Practical current
3		
5		
8		
10		
15		

CALCULATION:-

Let two resistor are connected in series then the total or equivalent resistance is …………………

PARALLELCIRCUIT:-

When a number of resistors are connected in such a way that they have a common positive and negativeterminal then the resistors are said to be connected in parallel with each other. In parallel connection of resistors the voltage remains the same across each resistor while the current across each resistor is different. The equivalent resistance (Req) of a parallel connection of resistors is given by-**$1/R_{eq}=1/R_1+ 1/R_2 + 1/R_3$**



PROCEDURE:-

PARALLEL CIRCUIT

1. Connect AC Supply to the kit .
2. Connect resistor R_2 parallel with resistor R_3. i.e connect T_{14} to T_{17} and T_{16} to T_{19}.
3. Connect 0 to 15 v variable DC supply-1(0 to 15) +ve of current meter and GND toT_{19}.
4. Connect -ve of DC current meter to T_{15} of resistance block.
5. Connect +ve terminal of DC voltmeter to (0 to 15) of variable DC supply-1 and -veto ground.
6. Switch on the power supply.
7. Change the power supply voltage by using Dot P1 as shown in table.
8. Observe the corresponding current on Ammeter.
9. You can further connect more resistance in parallel. To do so connect $T_{18}$to T_{21} and T_{20} to T_{23} .
10. Measure the current and voltage and note down the reading.

OBSERVATION TABLE:-

Voltage	When R= $R_2 \| R_3$= 0.5 KΩ	
V (Volt)	Theoretical current	Practical current
3		
5		
8		
10		
15		

CALCULATION:-

Let two resistor are connected in series then the total or equivalent resistance is …………………

EXPERIMENT NO-02(A)

AIMOFTHEEXPERIMENT:-To study and verify Ohm's Law.

APPRATUSREQUIRED:-

Sl.No	NameoftheComponents	Specification	Quantity
1	Trainer kit		
2	Ammeter		
3	Voltmeter		
4	Patch cords		

THEORY:-

Ohm's law can be stated that current in a circuit is directly proportional to the voltage and inversely proportional to the resistance in a circuit I.e. I = v/r

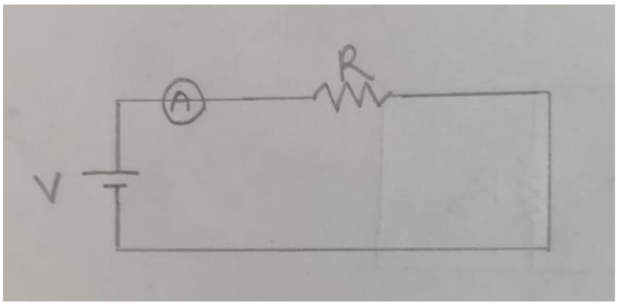
One of the fundamental laws describing how electrical circuits be have is Ohm's law.

According to Ohm's law, There is a linear relationship between the voltage drop

Across a circuit element and the current flowing through it ,Therefore the Resistance R is viewed as a constant independent of the voltage and the Current in equation from Ohm's law is V = IR - 2.1

Hence v is the voltage across the circuit in volts (V) is the current flowing through the circuit in units of Ampere(A) and R is the resistance of the circuit with units of Ohms(Ω) Eg 2.1 implies that for a resistor with constant resistor the current flowing through it is proportional to the voltage across it. If The voltage is held constant ,then the current is inversely proportional to the resistance If the voltage polarity is reverse (i.e.If the applied voltage is -ve instead of +ve) The same current flows but it in opposite direction If Ohm's law is valid, It can be used to define resistance R =V/I , Where R is constant and Independent of V and I

CIRCUIT DIAGRAM:-



Observation Table

Voltage V (volts)	Current I mA					
	When R =R2=1kΩR		WhenR=R2+R3=2RΩR		When R=R2+R3+R1=3kΩR	
3						
5						
8						
10						
15						

Procedure :-

1.Connect AC The Supply to the kit .

2.Connect 0 to 15 variable DC Supply-1(0 to 15) of the current meter & GND to T15.

3.Connect DC Voltmeter +ve to (0 to 15)& -ve to GND.

4.Connect -ve of DC current meter to T15 of resistance block.

5.Switch on the power supply.

6.Adjust the power supply voltage by using port p1 as shown in the table.

7. Observe the corresponding current on Ammeter.

8. Increase the resistance value further remove connection of GND T15 connect T15 to T17 and T19 to GND.

9. Measure the current and voltage and note down the readings.

10.Increase the resistance value further remove connection of T19 & GND Connect T19 to T21 and T23 to GND.

11.Measure the current and voltage and note down the reading.

12.Plot the Graph of voltage versus Current.

Conclusion

As Resistance in circuit is connected, current is proportional to the applied voltage.

EXPERIMENT NO-2(B)

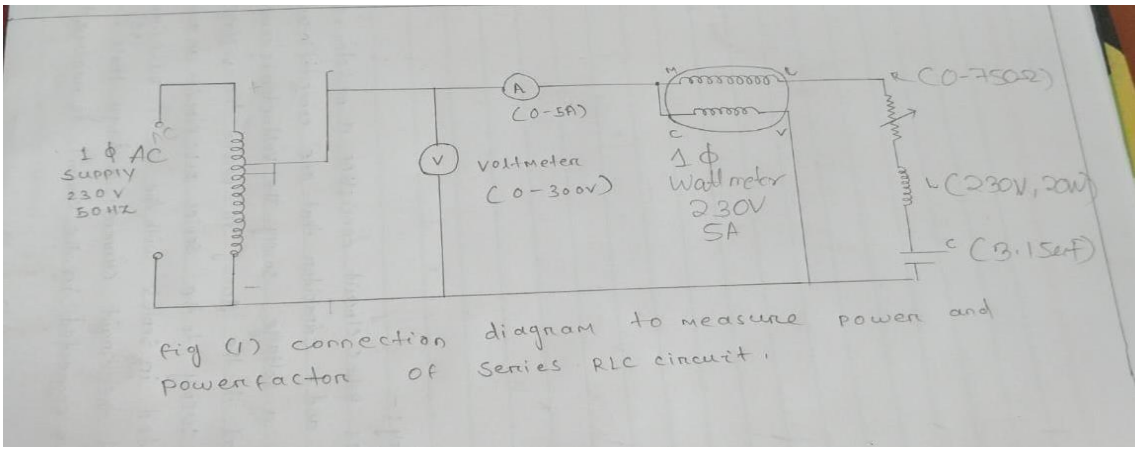
AIM OF THE EXPERIMENT – To measure the power and power factor using series R-L-C Load

APPARATUS REQUIRED-

SI.NO	NAME OF THE EQUIPMENT	SPECIFICATION	QUANTITY
1	1ϕ Variac	0-250V	1
2	MI Voltmeter	0-300V	1
3	MI Ammeter	0-5A	1
4	1ϕ Wattmeter	230v, 5A	1
5	Variable Resistor	0-750 Ω	1
6	Inductor	230V,0.35A,20W	1
7	Capacitor	3.15μ F	1
8	Connecting Wires	-	As per requirement

THEORY- A series RLC circuit is one that consists of a resistor, capacitor and aninductor that are connected in series with each other. The voltmeter is connected in parallel to the circuit to record the value of voltage supplied by the voltage source. The ammeter is connected in series with the circuit to record the value of circuit current. The wattmeter measures the power being consumed by the series RLC load.

CIRCUIT DIAGRAM-



PROCEDURE-

1) Connections were done as per the circuit diagram
2) Power supply was being switched ON
3) Readings from voltmeter and ammeter were noted to know the valuesof supply voltage & circuit current respectively
4) Readings from wattmeter were obtained to determine the power consumed by the series RLC load
5) Voltmeter & ammeter readings were multiplied and the result so obtained was divided by the wattmeter reading to obtain the power factor of the series RLC circuit

TABULATION-

SI.NO	Voltmeter Reading in V	Ammeter reading in A	Wattmeter Reading in W	Pf=W/(V*I)
1				
2				
3				

CONCLUSION- Hence the power and power factor of the series RLC circuit was measured.

EXPERIMENT NO–03

AIMOFTHEEXPERIMENT:-To study and verify KCL and KVL.

APPARATUS REQUIRED:-

Sl.No	Name of the Components	Specification	Quantity
1	Trainer kit		
2	Ammeter		
3	Voltmeter		
4	Patch cords		

CONCEPT:-

Kirchhoff's laws are two equalities that deal with the current and voltage difference in the lumped element model of electrical circuit .They are also called as Kirchhoff's rule or Kirchhoff's laws.

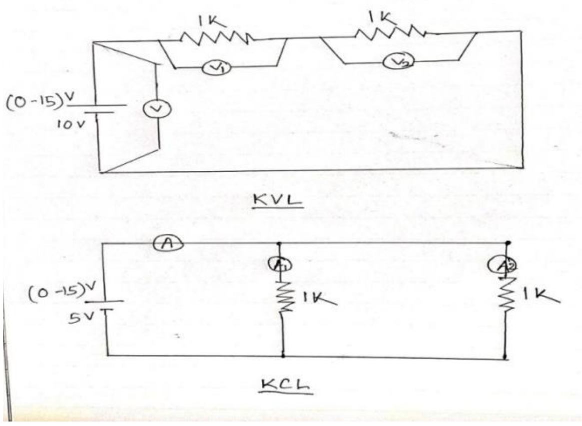
Both of Kirchhoff's laws can be understood as corollaries of the Maxwell equation in the law frequency limit They are accurate for DC circuit and for AC circuits at frequency where the wave length of electromagnetic radiation are very large compoundto the circuit.

Kirchhoff's voltage law

Kirchhoff's voltage law can be stated that the sum of all the voltage in a closed Lines circuit is zero . Connections of current flow is assumed as from positive to negative.

Kirchhoff's current law

Current law can be stated that sum of current meeting at a point is zero.



Voltage lawProcedure

1.Connect the AC supply to the kit.

2.Connect 0 to 15 variable DC Supply-1(0 to 15) to $T_{13}$and GND to $T_{19}$of resistance Block and set it to 10 volt with the help of port p_{1}.

3.Connect Positive terminal of DC Voltmeter to T_{14}.and negative terminal of DC

volt meter to T_{16}.This is voltage v_{1}.

4.Connect $T_{15}$to T_{17}.

5.Connect positive terminal of another DC voltmeter to T_{18} and negative terminal of DC voltmeter to T_{20}.The voltage is V_2.

6.Measure voltage V_1& V_2 across R2 and R3 using DC voltmeter respectively .

7. Record the observation in the table .

8.Reapet the procedure for ckt supply voltage of 15 volts and recored the observation.Care should be taken to monitor polarity of voltageacross R2 and R3.

9.From the observation ,Verify,V=V1+V2 i.e. applied voltage equals the sum voltage

Across R2 and R3.

OBSERVATION TABLE

Supply voltage V	**Voltage across R2 V1**		**Voltage across R3 V2**	
	Theoretically	**Practically**	**Theoretically**	**Practically**
10				
15				

Current law Procedure :-

1. Connect the AC supply to the kit.

2. Connect (0 to 15v) DC variable supply -1(0 to +15) to positive of the current meter and –ve to to T13 and set it to 5 volt with the help of port P1.The current meter will give the current I.

3. Connect T14 to T17.

4. Connect +ve terminal of DC Current meter to T15 and _ve terminal of DC Current meter to GND .This current is I1.

5. Connect +ve terminal of another DC Current meter to T19 and –ve terminal of DC Current meter to GND.This current is I2.

6. Observe and measure common current I and current flowing through R2(i1) and R3(I2).

7. Record the observation in table below.

8. Set the total current as per observation table.

OBSERVATION TABLE

I(mA)	**I1 (mA) across R2**		**I2 (mA) across R3**	
	Theoretically	**Practically**	**Theoretically**	**Practically**
5				
10				
15				

Conclusion

1. The sum of all Voltages in a closed linear circuit is Zero.
2. The sum of all currents entering and leaving of a junction is Zero.

EXPERIMENT NO–04

AIMOFTHEEXPERIMENT:-To study and verify Super position theorem.

APPARATUS REQUIRED:-

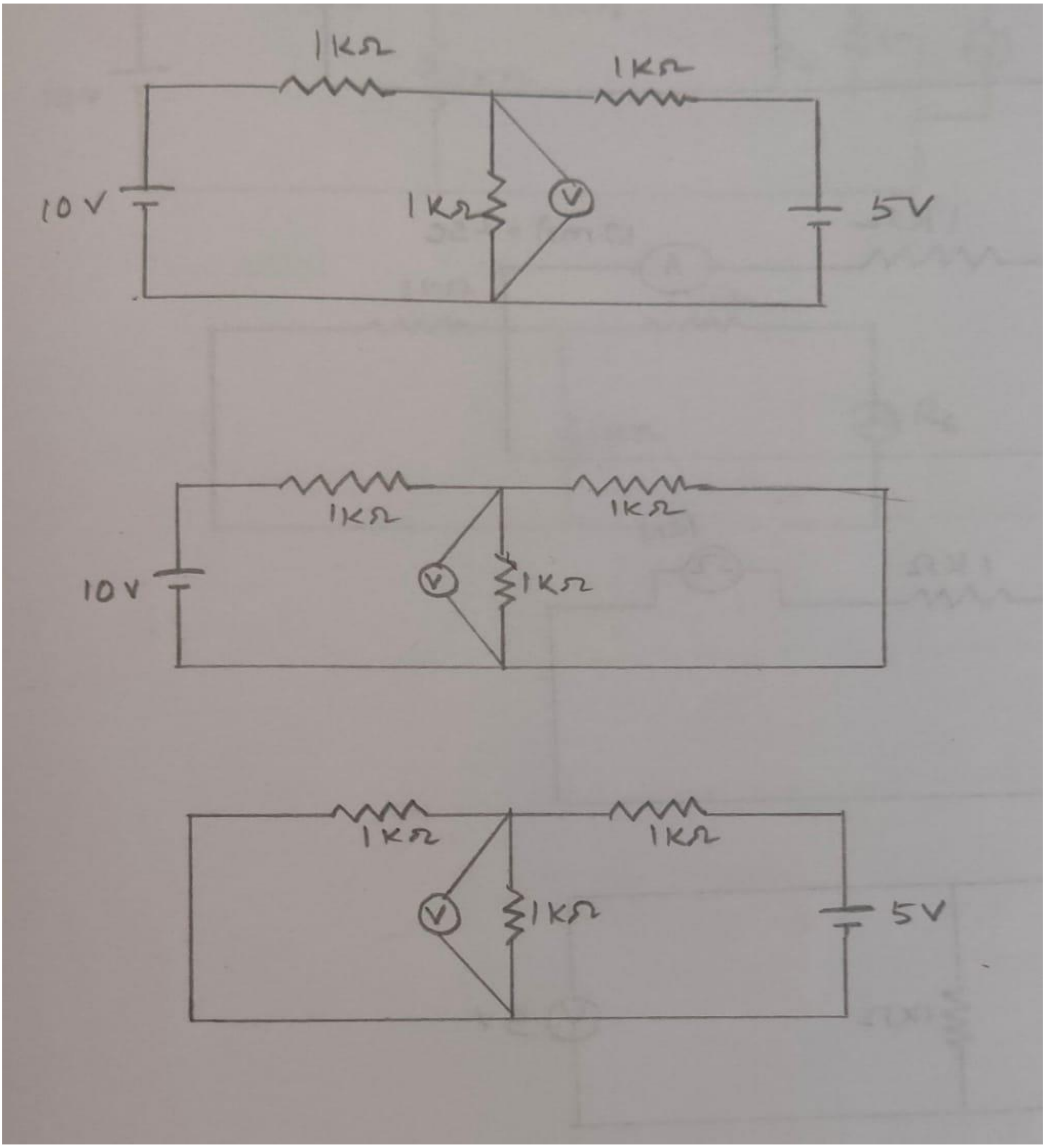
Sl.No	Name of the Components	Specification	Quantity
1	Trainer kit		
2	Ammeter		
3	Voltmeter		
4	Patch cords		

Theory

Superposition theorem can be stated as a network consisting two or more sources like the current or voltage at any point equal to the sum of current or voltage produced by each source separately (Other source replaced by internal resistance).

The Superposition theorem for electrical circuit stated that for a linear system the Responses(voltage or current) in any branch of a bilateral linear circuit having more than one independent source equals to the algebraic sum of the responses caused by each independent source acting alone, Where all the other independent sources are replaced by their internal impedances .

CIRCUIT DIARAM:-



Procedure

1. Connect the AC Supply to the Kit
2. Connect **0 to 30V DC VARIABLE SUPPLY-2 (0 to +30)** to **T13. Set it at 10V** with the help of Pot **P2.**
3. Connect **0 to 15V DC VARIABLE SUPPLY-1 (0 to +15)** to **T19. Set it at 5V** with the help of Pot **P1.**
4. Connect **T15** to **T18.**
5. Connect **+ve** terminal of DC Voltmeter to **T16** and **–ve** terminal of DC Voltmeter to **GND.**
6. Switch **ON** the power supply.
7. Measure the Voltage at T16 (junction point of R_2 and R_3) with respect to ground and Note down the readings. . This voltage is V_T
8. Remove **0 to 15V DC VARIABLE SUPPLY-1 (0 to +15)** from **T19** & short **T19** to **GND.** (Supply replaced by its internal resistance which is assumed as zero).
9. Measure junction voltage at **T16** with respect to ground. Record it as V_1
10. Reconnect **0 to 15V DC VARIABLE SUPPLY-1 (0 to +15)** to **T19. Set it at 5V**
11. Disconnect **0 to 30V DC VARIABLE SUPPLY-2 (0 to +30)** from **T13** & connect **T13** to **GND.**
12. Measure junction voltage on DC Voltmeter at **T16** with respect to ground. Record it as V_2.
13. Similarly set **DC VARIABLE SUPPLY-2** to **8V** & **DC VARIABLE SUPPLY-1** to **5V.**
14. Repeat the step from Step-7 to Step-12.
15. Similarly set **DC VARIABLE SUPPLY-2** to **6V** & **DC VARIABLE SUPPLY-1** to **3V.**
16. Repeat the step from Step-7 to Step-12.
17. Verify

$$V_1 + V_2 = V_T$$

Where, V_T is measured voltage when both power supplies connected

Observation Table

0-30V	0 – 15 V	V1	V2	VT	
				Measured	Calculated
10 V	5 V				
8 V	5 V				
6 V	3 V				

Conclusion

Observation shows that a network consisting of two sources can be replaced by internal Resistance (assumed to be zero).

EXPERIMENT NO–05

AIMOFTHEEXPERIMENT:-To study and verify Thevenin's theorem.

APPARATUS REQUIRED:-

Sl.No	Name of the Components	Specification	Quantity
1	Trainer kit		
2	Ammeter		
3	Voltmeter		
4	Patch cords		

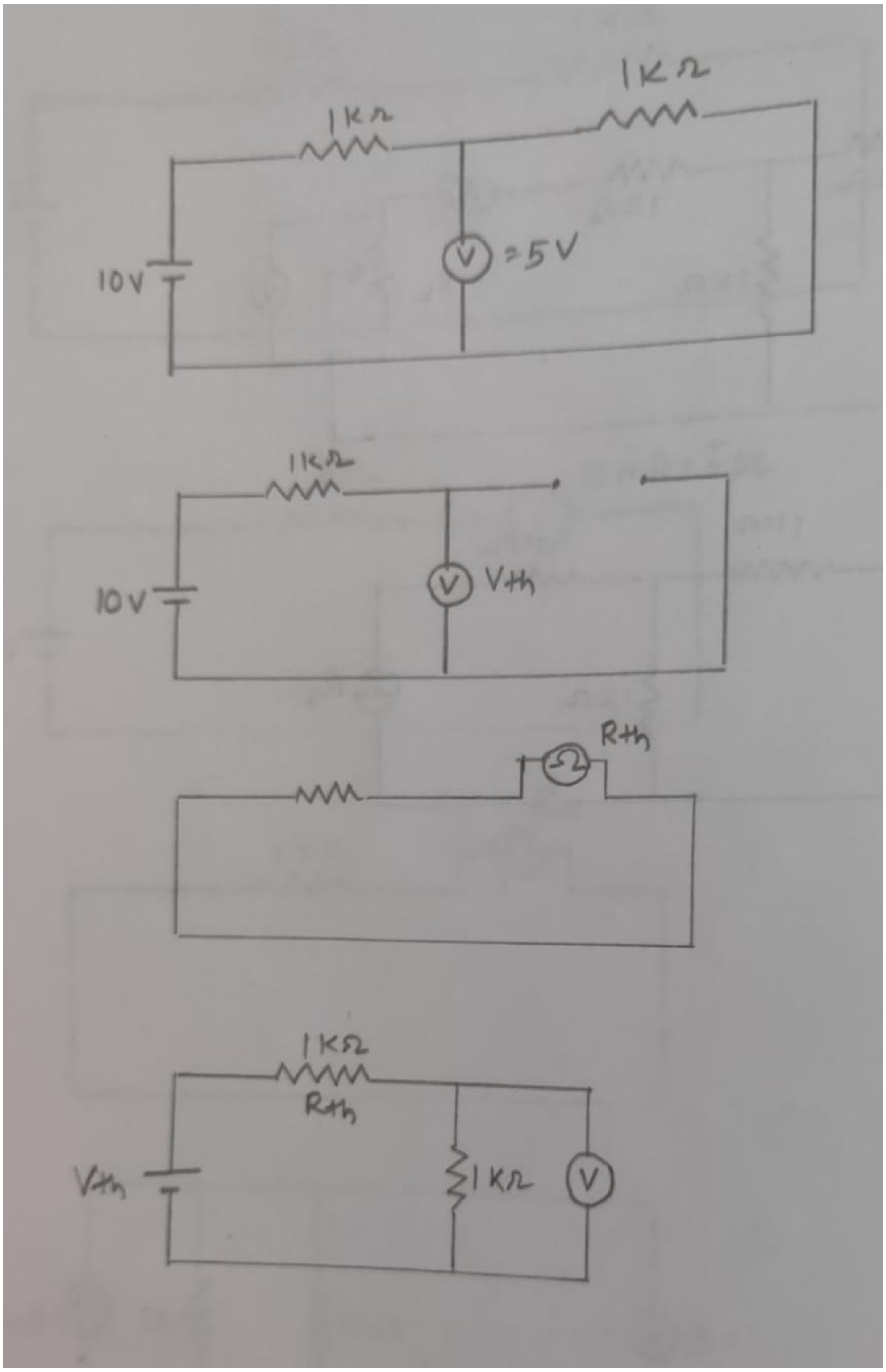
Theory

Thevenin's Theorem can be stated as any two terminal network can be replaced by a network consisting of a voltage source in series with a resistance .The voltage is the open circuit voltage of a two terminal network and resistance equal to resistance looking into the terminal of two terminals network.

How to Thevenize a Given Circuit ?

1) Temporarily remove the resistance(called load resistance R_L) whosecurrent is required
2) Find the open circuit voltage V_{OC} which appears across the two terminalsfrom where resistance has been removed. It is also called Thevenin voltage V_{TH}
3) Compute the resistance of the whole network as looked into from thesetwo terminals after all voltage sources have been removed leaving behind their internal resistances (if any), it is also called Thevenin'sresistance R_{TH}
4) Replace the entire network by a single Thevenin source, whose voltage isV_{TH}, and whose internal resistance is R_{TH}
5) Connect R_L back to its terminals from where it was previously removed
6) Finally, Calculate the current flowing through R, by using the equation $I=V_{TH}/(R_{TH}+R_L)$.

CIRCUIT DIARAM:-



PROCEDURE

1. Connect the AC Supply to the Kit.
2. Connect **0 to 15V DC VARIABLE SUPPLY-1 (0 to +15)** to **T13** and **GND** to **T19**. **Set it at 10V** with the help of Pot **P1**.
3. Connect **T15** to **T17** with the help of 2mm patch chord.
4. Connect **+ve** terminal of DC Voltmeter to **T16** and **–ve** terminal of DC Voltmeter to **GND**
5. Switch **ON** the power supply.
6. Now measure voltage across R3 (Resistance between T17 & T19) and name it as **V2**.

This is the open circuit Voltage, **V2** = ... V

7. Now remove the voltmeter and power supply connections i.e. remove **0 to +15V** from **T13** and remove **T19** from **GND**.
8. Short circuit the terminals where power supply connected i.e. short **T13 and T19**.
9. Now measure the resistance into the network using multimeter.
10. Measure resistance across terminals of Resistor **R3** (Across **T18** & **T20**).
11. Record open circuit voltage and resistance.
12. Now you can construct a circuit as shown below and can be used as Thevenin's equivalent circuit.

Conclusion

Thevenin's Theorem is verified.

EXPERIMENT NO–06

AIMOFTHEEXPERIMENT:-To study and verify Norton's theorem.

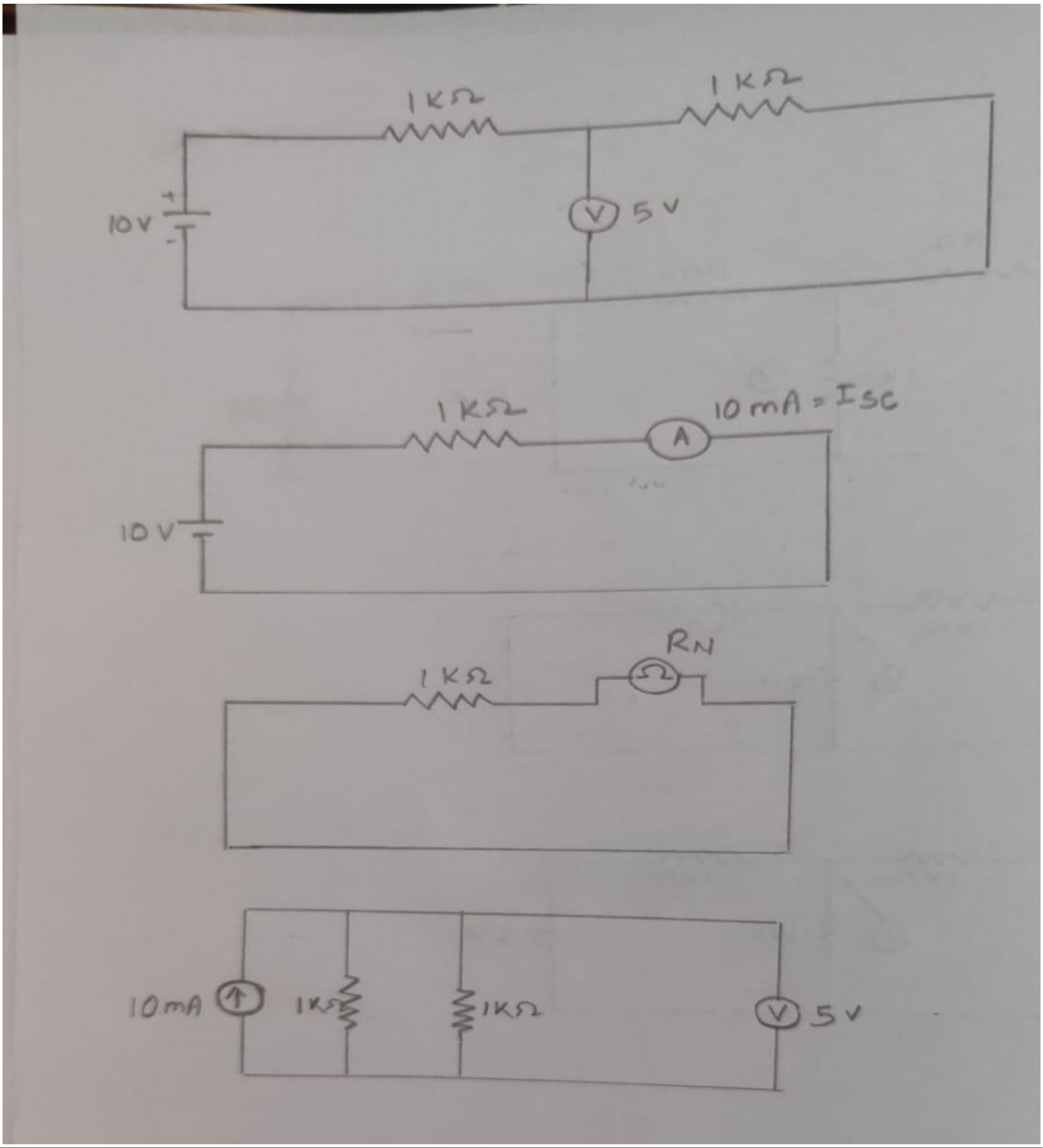
APPARATUS REQUIRED:-

Sl.No	Name of the Components	Specification	Quantity
1	Trainer kit		
2	Ammeter		
3	Voltmeter		
4	Patch cords		

Theory

Norton Theorem's states that any two terminal active network containing voltage sources and resistances when viewed from its output terminals, is equivalent to a constant current source(Isc) and a parallel resistance (RNOR). The constant current is equal to the current which would flow in a short circuit placed across the terminals & parallel resistance is the resistance of the network when viewed from these open circuited terminals after all voltage sources have been removed and replaced by their internal resistance (if any).

CIRCUIT DIAGRAM:-



Procedure

1. Connect the AC supply to the kit.
2. Connect (0 -15) V DC variable supply to T13 and GND to T16 and set it 10 V with the help of pot1.
3. Connect T16 to T17 and T19 to GND.
4. Connect the positive terminal of a voltmeter to T16 and negative terminal to the GND and record the reading of the voltmeter .
5. Now disconnected the resister(T17 to T20) and short T16 to GND with the help of an ammeter and record the reading of ammeter i.e. Isc.
6. Now replace the ammeter by an ohm meter and short T13 and negative terminal of ohm meter and record the resistance value of ohm meter , which is Rn
7. Now construct a circuit heaving a current source parallel with a resistance the value of current source Isc which is measured earlier and value of parallel resistance Ris measured also earlier.
8. Now reconnect the resistor (T17 -T20) with the above construct circuit and set the source current Isc =10 mA with the help of ammeter connecting between supply (0 – 15)V and T13.Tne voltage across the resistor (T17 -T20) with the help of a voltmeter and note down the value.

Conclusion

In this experiment we have successfully verified the Norton's theorem.

EXPERIMENT NO–07

AIMOFTHEEXPERIMENT:-To study and verify Maximum power transfer theorem.

APPARATUS REQUIRED:-

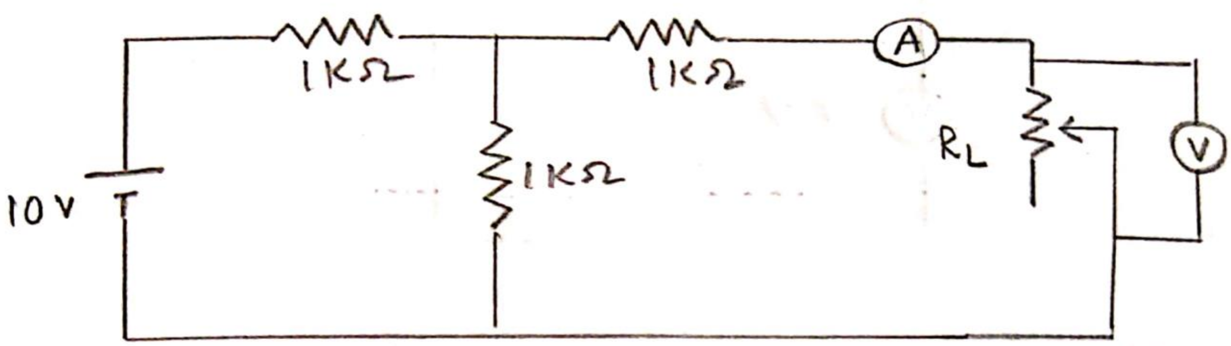
Sl.No	Name of the Components	Specification	Quantity
1	Trainer kit		
2	Ammeter		
3	Voltmeter		
4	Patch cords		

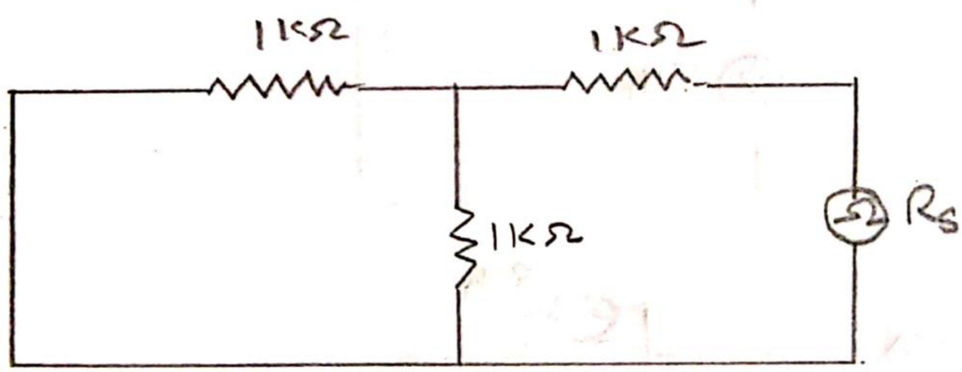
Theory

When load is connected across a voltage source, power is transferred from the source to the load the amount of power transferred will depend upon the load resistance. If load resistance R_L is made equal to the internal resistance R of the source, then maximum power is transferred to the load R_L. This is known as maximum power transfer theorem and can be stated as follows:

"Maximum power is transferred from a source to a load when the load resistance is made equal to the internal resistance of the source". This appliesto DC as well as AC power.

CIRCUIT DIARAM





Procedure

1. Connect the AC supply to the kit.
2. 0 to 15 volt DC **VARIABLE SUPPLY -1(0 to +15) TO T1 & GND to T6.Set it to 10 volt.** With the help of port **P1.**
3. Connect +ve terminal of DC voltmeter to T59 AND negative terminal of DC voltmeter to T58.
4. Put the pot P5 in fully anti clockwise position.
5. Connect +ve terminal of DC current meter to T4 and -ve terminal of DC current meter to T59.
6. Connect T58 to GND.
7. Switch ON the power supply.
8. Read output current and voltage across $R_L$on DC current meter & DC current meter, respectively .
9. Vary the load resistance pot P5 by rotating in clockwise direction and note down the current and voltage.
10. Set the value of $R_L$with the help of pot P5 by connecting multimeter(In resistance mode) at T58 and T59, as below table and record corresponding current.
11. Now remove the power supply connections i.e. remove 0to +15 volt from T1 and remove T6 from GND.
12. Short T1 and T6 with the help of patch chords. and keep R_L= 0
13. Measure output resistance of network by multimeter(Measured 1.5kΩ).
14. Plot the graph of load resistance R_L versus outpower.
15. Find out maximum power from graph.

Observation table

R_L Ohms	Current(I) mA	Output Power $P = I^2R_L$	Voltage V	Output power $P = V^2/R_L$
0Ω				
500Ω				
1kΩ				
1.5kΩ				
3kΩ				
5kΩ				

Graph

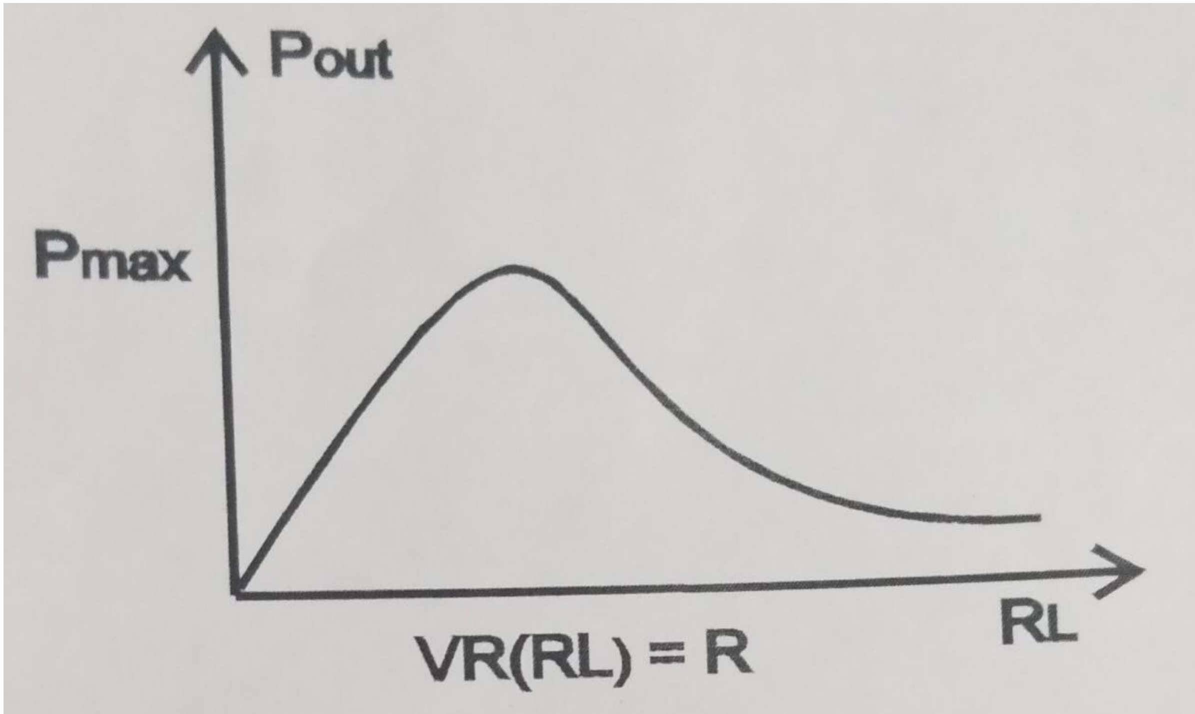


FIG. (15)

Conclusion

- Observation and graph shows that at particular value of R_L output is maximum.
- This value near to the circuit resistance measured by multimeter.

EXPERIMENT NO–08

AIMOFTHEEXPERIMENT:- To determine resonant frequency of series R-L-C circuit.

APPARATUS REQUIRED:-

Sl.No	Name of the Components	Specification	Quantity
1	Trainer kit		
2	Ammeter		
3	Voltmeter		
4	Patch cords		

Theory:-

There are circuits, which are used in radio equipments, to select and amplify particular frequency. Such amplifiers which are used to amplify selected frequency called Tuned Amplifier. These amplifiers used a tuned circuit (A L, R, C Network or Tank Circuit) for selection of a particular frequency. The selected frequency depends upon resonance frequency of tuned circuit. Therefore it is important to study the phenomenon ofResonance in AC circuit.

Before all that, let we name the electronic components involved in Resonance. Inductor is an electronic component opposis the change of current. The ability of Inductor with which it opposes the change of current through it is known as its inductance, it is denoted by (L) and measured in Henry (H) after the name Joseph Henry. The amount of opposition offered by Inductor is measured in terms of reactance called Inductive reactance and denoted by

$X_L = \omega L$

Similarly capacitors are electronics component which provide easy path to highly change current & appose slowly changing current and capacitance is property of capacitors by virtue of which they let the highly changing current easily. It is denoted by "C" & measured in farad. The amount of easyness offered by capacitor to changing (varying) amount is measured in terms of capacitive reactance (Xc)

$$Xc = 1 / \omega c$$

Last one is Resistance, resistance is electronic component which oppose the flow of (Direct & Alternating current through it, the ability of resistor to oppose the flow of current is known of resistance, denoted by "R" and measured in ohm (Ω).

RESONANCE :

The phenomenon of resonance occurs only in AC circuits containing Inductance (L) and Capacitance (C). The circuit also contain Resistance (R) which may be the effective resistance of the coil itself or a resistance deliberately introduced into the circuit to create some desired results.

The circuit containing the above parameters may behave as an inductive circuit or capacitive circuit when connected across an AC supply. However, when the supply frequency is such that inductance reactance is equal to capacitive reactance (i.e, $X_L = X_C$), the circuit behaves as a pure resistive circuit and current supplied to the circuit is in phase with the supply voltage. This phenomenon is called resonance and the frequency at which this phenomenon occurs is called resonant frequency.

Thus, the phenomenon by which in an AC circuit, at a particular frequency, inductive reactance becomes equal to capacitive reactance is called **Resonance** and the frequency at which this phenomenon occurs is called **Resonant Frequency**.

The components L & C may be connected in series or in parallel, according they are known as series resonance circuit and parallel resonance circuit respectively.

Analysis :

A. SERIES RESONANCE :

Resonance Frequency :-

In series resonance circuit, R,L & C are connected in series across an AC source as shown in Fig. (1) at a given frequency

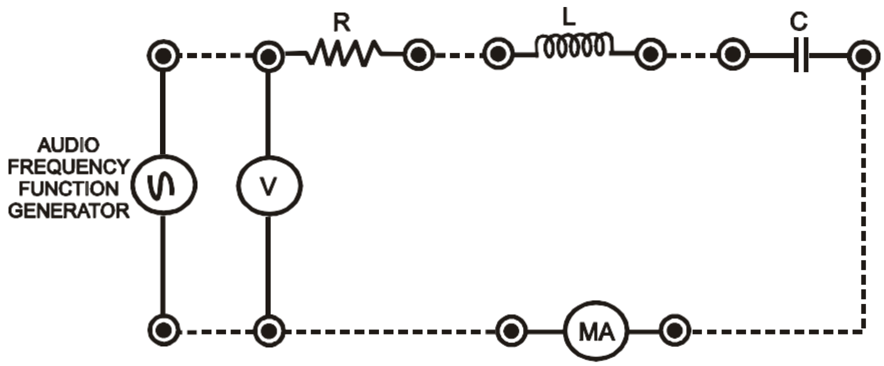


FIG. (1) SERIES RESONANCE

$X_L = \omega L$ ------------------------(i)

$X_C = 1/\omega C$ ------------------------(ii)

where $\omega = 2\pi/T = 2\pi f$

At resonance (w =wr) $X_L = X_C$ ------------------------(iii)

Putting (i), (ii) in (iii) at $\omega = \omega r$

$$\omega_{rL} = 1/\ \omega_{rC}$$

$$\omega^{2}_{r} = 1/\ LC$$

$$\omega_{r} = 1/\ (LC)^{½}$$

$$f_{r} = ½\pi\ (LC)^{½}$$

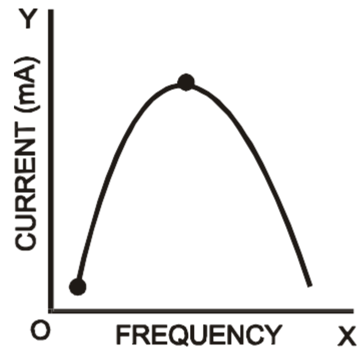


FIG. (2)
SERIES RESONANCE CURVE

Quality Factor : -

The rates of voltage drop across L or C to the voltage drop across R at series resonance is called Quality Factor. It is also called figure of merit at resonance maximum current (Ir) flows through L & R.

Voltage drop across "L" = $Ir\ X_L$

Voltage drop across "R" = $Ir\ R$

$$Q = X_L / R = \omega_{rL} / R = 2\pi f_{rL} / R$$

Graphical Representation (Resonance Curve) :-

The curve plotted between current flowing in circuit and supply frequency called **Resonance Curve**.

In series resonance at resonance frequency the circuit impedance is minimum and hence the current drawn by the circuit is maximum. The magnitude of current decreases as frequency deviates from Fr on otherside. The resonance curve for series resonance is shown in the Fig. (2).

Procedure

1.Connect the circuit as shown in Figure (1) i.e, R = 50Ω , L = 30mH, C = 0.1μF.

2.Adjust the Sine Wave signal of oscillator at 3V r.m.s., 1kHz

3.Increase the frequency of signal upto 10kHz and note down the corresponding value of frequency and current. Record the observations in Table No. (1). The frequeny where current starts decreasing is known as resonance frequency.

Formula used to calculate resonance frequency is :

$$f = 1/ 2\pi(LC)^{1/2}$$

and formula used to calculate quality factor is :

$$\text{Quality Factor (Q)} = (L/C)^{1/2}/ R$$

4.Repeat steps 1 -3 for different values of R & C

5. Plot a graph between Frequency v/s Current as shown in Fig. (3).

TABULATION-

SI.NO	FREUENCY IN Khz	CURRENT	VOLTAE

CONCLUSION- Hence the resonant frequency of series R-L-C circuit was beingdetermined and the theoretical and practical values so obtained were same.

EXPERIMENT NO–09

AIM OF THE EXPERIMENT:- To study a low pass filter and determine the cut-offfrequency

APPARATUS REQUIRED:-

Sl.No	Name of the Components	Specification	Quantity
1	Trainer kit		
2	Function Generator		
3	Cathod Ray Oscilloscope(CRO)		
4	Patch cords		

Theory:-

A filter is an electrical network that can transmit signals within a specified frequency range. This frequency range is called pass band and other frequency band where the signals are suppressed is called attenuation band or stop band.The frequency that seprates the pass and attenuation bands is known as cut-off frequency.There may also be two cut off frequencies in the entire zone of operation of the filter.The cut off frequency is usually symbolised as f_c in case its value is unique or by f_1 and f_2 in case the cut off frequencies are more than one ($f_1$indicates lower cut off while the f_2 indicates higher cut off frequency).

An ideal filter would transmit signals under the pass band frequencies without attenuation and completely suppress the signal with attenuation band of frequencies with a sharp cut off profile.Practical filters do not ideally transmit the pass band signal unattenuated due to absorption,reflection or due to other loss.This results in loss of signal power.Also,the filters do not completely suppress the signal in attenuation bands.In passive filters,the circuit components -capacitor and inductor -are arranged in different circuit configurations to make the passive filter.

Low Pass Filter (LPF) :

It is the simplest type of filter which allows all frequencies,upto the specified cut off frequency, to pass through it and attenuates all the other frequencies above the cut off frequency. Cut off frequency demarcates the pass band and the stop band.

Low Pass Filter (Design for cut-off Frequency of 7.5KHz) :

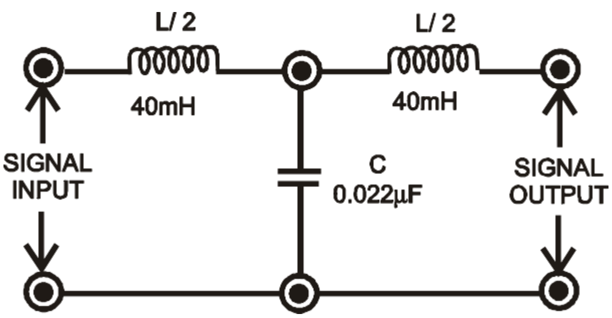


FIG. (1)

1. Study the circuit configuration for Low Pass Filter printed on the front panel carefully.

2. Connect the output of Audio Frequency Function Generator across signal input of Low Pass Filter.

3. Set the output of Audio Frequency Function Generator at Sine Wave of 2V peak to peak amplitude, 100Hz frequency.

4. Connect CRO (Cathode Ray Oscilloscope) across signal output sockets of the filter.

5. Switch ON both the instruments i.e, Function Generator & CRO.

6. Increase the frequency of Function Generator towards 10kHz range in small steps and note down output voltage on CRO everytime. You wil observe on the CRO that below 7.5kHz frequencies, the filter passes input signal completely (i.e, output voltage amplitude will remain 2V peak to peak or more than 2V peak to peak). But after 7.5kHz frequency the filter will starts to attenuate or supress the output signal amplitude

(Signal amplitude reduces from 2V peak to peak amplitude). This frequency where the filter circuit starts to attenuate the signal is known as the cut-off frequency. Note down all the observation in Table No. (1).

Sr. No.	Frequency	Input Voltage V	Output Voltage V_{OUT}	Gain=$20\log_{10} V_{OUT}/V_{IN}$
1				
2				
3				
4				
5				

OBSERVATION TABLE NO. 1

7. Plot the graph between output Voltage & Frequency or output gain vs frequency as shown in Fig. (1a).

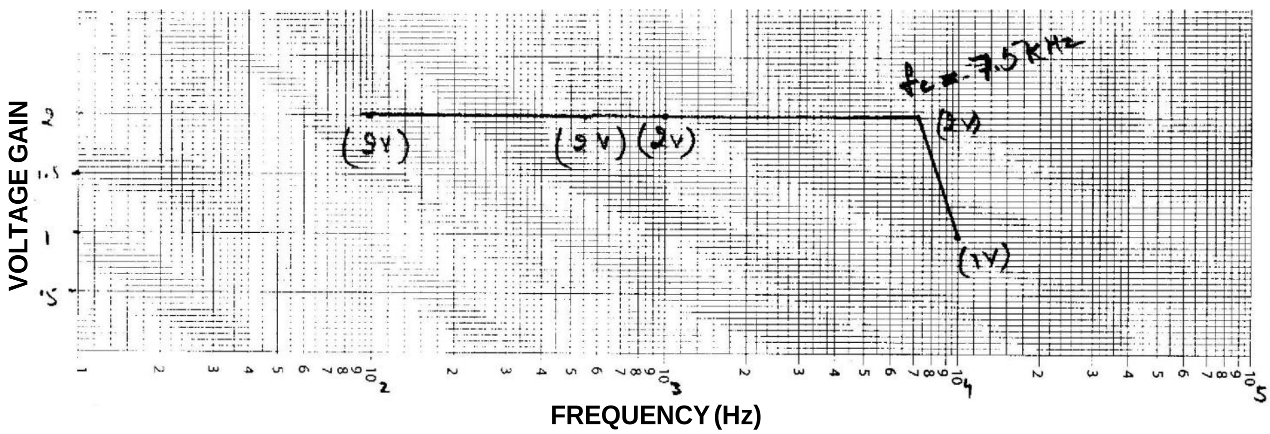


FIG. (1a)

Formula used to calculate the cut-off frequency (fc) is

$$fc = 1/\pi\ (LC)^{1/2}$$

$$= 1/\ 3.14\ [(80 \times 10^{-3})\ (0.022 \times 10^{-6})]^{1/2}\ \text{Hz}$$

$$= 7.58\ \text{kHz}$$

The nominal design impedance (R0) is given as

$$Ro = (L/C)^{1/2}$$

$$= [(80 \times 10^{-3}) / (0.022 \times 10^{-6})]^{1/2}\ \Omega$$

$$= 1.907\ \text{k}\Omega$$

CONCLUSION- Hence the low pass filter was being studied and the cut offfrequency was being determined.

EXPERIMENT NO–10

AIM OF THE EXPERIMENT:- To study a High pass filter and determine the cut-offfrequency

APPARATUS REQUIRED:-

Sl.No	Name of the Components	Specification	Quantity
1	Trainer kit		
2	Function Generator		
3	Cathod Ray Oscilloscope(CRO)		
4	Patch cords		

Theory:-

A filter is an electrical network that can transmit signals within a specified frequency range. This frequencyrange is called pass band and other frequency band where the signals are suppressed is called attenuation band or stop band.The frequency that seprates the pass and attenuation bands is known as cut-off frequency.There may also be two cut off frequencies in the entire zone of operation of the filter.The cut off frequency is usually symbolised as f_c in case its value is unique or by f_1 and f_2 in case the cut off frequencies are more than one (f_1 indicates lower cut off while the f_2 indicates higher cut off frequency).

An ideal filter would transmit signals under the pass band frequencies without attenuation and completely suppress the signal with attenuation band of frequencies with a sharp cut off profile.Practical filters do not ideally transmit the pass band signal unattenuated due to absorption,reflection or due to other loss.This results in loss of signal power.Also,the filters do not completely suppress the signal in attenuation bands.In passive filters,the circuit components -capacitor and inductor -are arranged in different circuit configurations to make the passive filter.

High Pass Filter (HPF) :

Simply speaking, a high pass filter is the reverse of a low pass filter. This filter attenuates all frequency below the cut off frequency and allows to pass other frequencies above the cut off frequency.

PROCEDURE

High Pass Filter (Design for cut-off Frequency of 10.7KHz) :

1. Study the circuit configuration for High Pass Filterprinted on the front panel carefully.

2. Connect the output of Audio Frequency FunctionGenerator across signal input of High Pass Filter.

3. Set the output of Audio Frequency Function Generator
at Sine Wave of 2V peak to peak amplitude, 1kHz frequency.

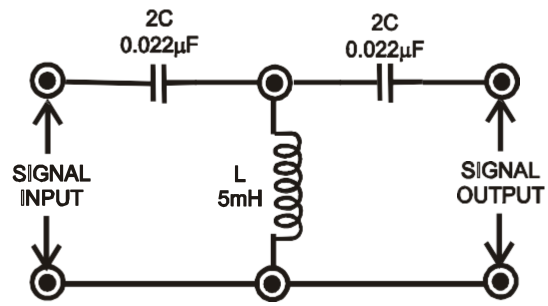


FIG. (2)

4. Connect CRO (Cathode Ray Oscilloscope) across signal output sockets of the filter.

5. Switch ON both the instruments i.e, Function Generator & CRO.

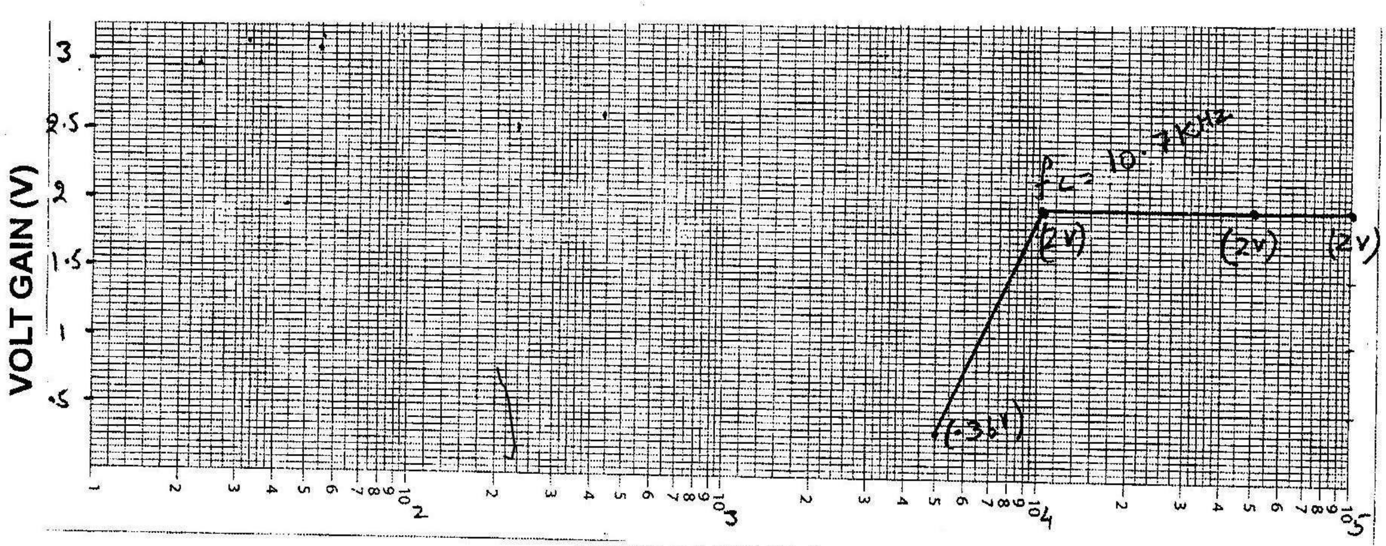
6. Increase the frequency of Function Generator towards 10kHz range in small steps and note down output voltage on CRO everytime.

Sr. No.	Frequency	Input Voltage V	Output Voltage V_{OUT}	Gain=$20\log_{10} V_{OUT}/V_{IN}$
1				
2				
3				
4				
5				

OBSERVATION TABLE NO. 2

At frequency range approximate 10.7KHz, you wil observe that the output amplitude of the signal on CRO approches to input signal voltage i.e, 2V peak to peak. It means the filter

= $1/ 4 \times 3.14 (5 \times 10^{-3}) (0.011 \times 10^{-6})^{½}$ Hz



FREQUENCY (Hz)

FIG. (2a)

Formula used to calculate the cut-off frequency (fc) is

$$fc = 1/\ 4\pi\ (LC)^{1/2}$$

$$= 10.73KHz$$

CONCLUSION- Hence the high pass filter was being studied and the cut offfrequency was being determined.

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EXPERIMENT NO–11

AIM OF THE EXPERIMENT:- To analyze the charging and discharging ofan R-C & R-L circuit with oscilloscope and compute the time constant from the tabulated data and determine the rise time graphically.

APPARATUS REQUIRED:-

Sl.No	Name of the Components	Specification	Quantity
1	RL,RC time constant Trainer kit		
2	Cathod Ray Oscilloscope(CRO)		
3	Patch cords		

THEORY- When a circuit is switched from one condition to another either by a change in applied voltage or by change in one of the circuit elements there is a transitional period during which the branch currents and voltage drops change from their former values to new ones. After this transition interval called the transient, the circuit is said to be in steady state.

The time constant of an RL circuit is the equivalent inductance divided by the Thevenin's resistance as viewed from the terminals of the equivalent inductor.

t= L/R

The time constant of an RC circuit is the product of equivalent capacitance andthe Thevenin's resistance as viewed from the terminals of the equivalent capacitor t= R*C

CONNECTION DIAGRAM-

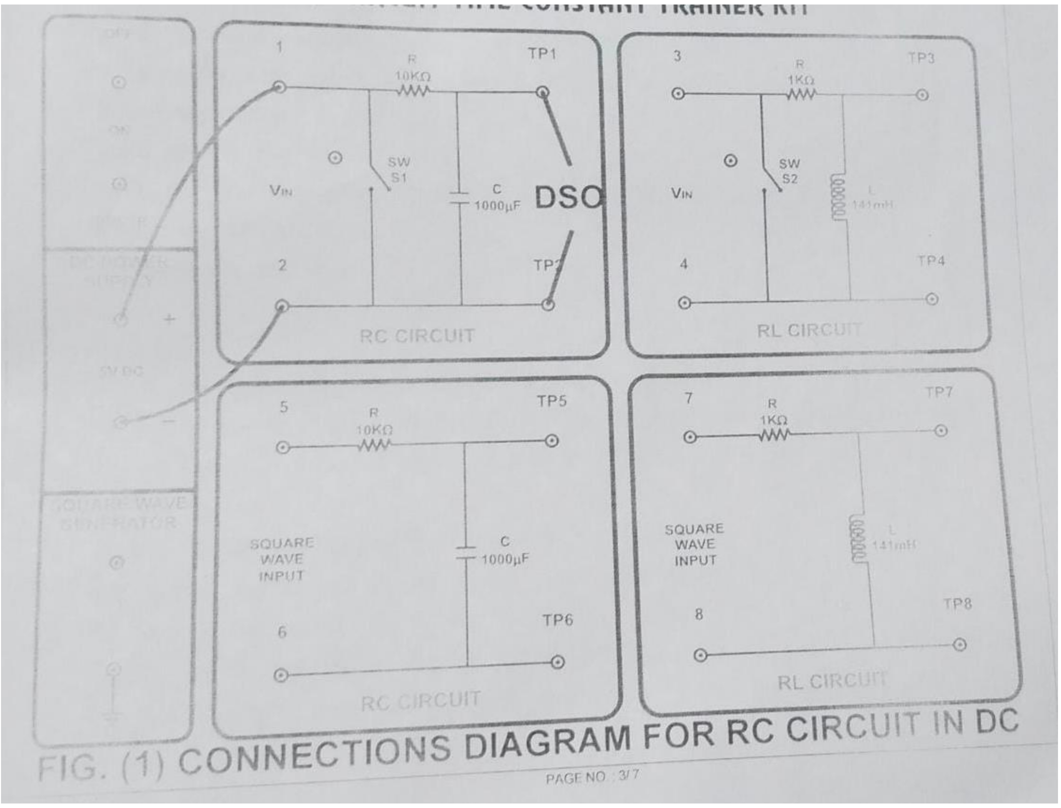


FIG. (1) CONNECTIONS DIAGRAM FOR RC CIRCUIT IN DC

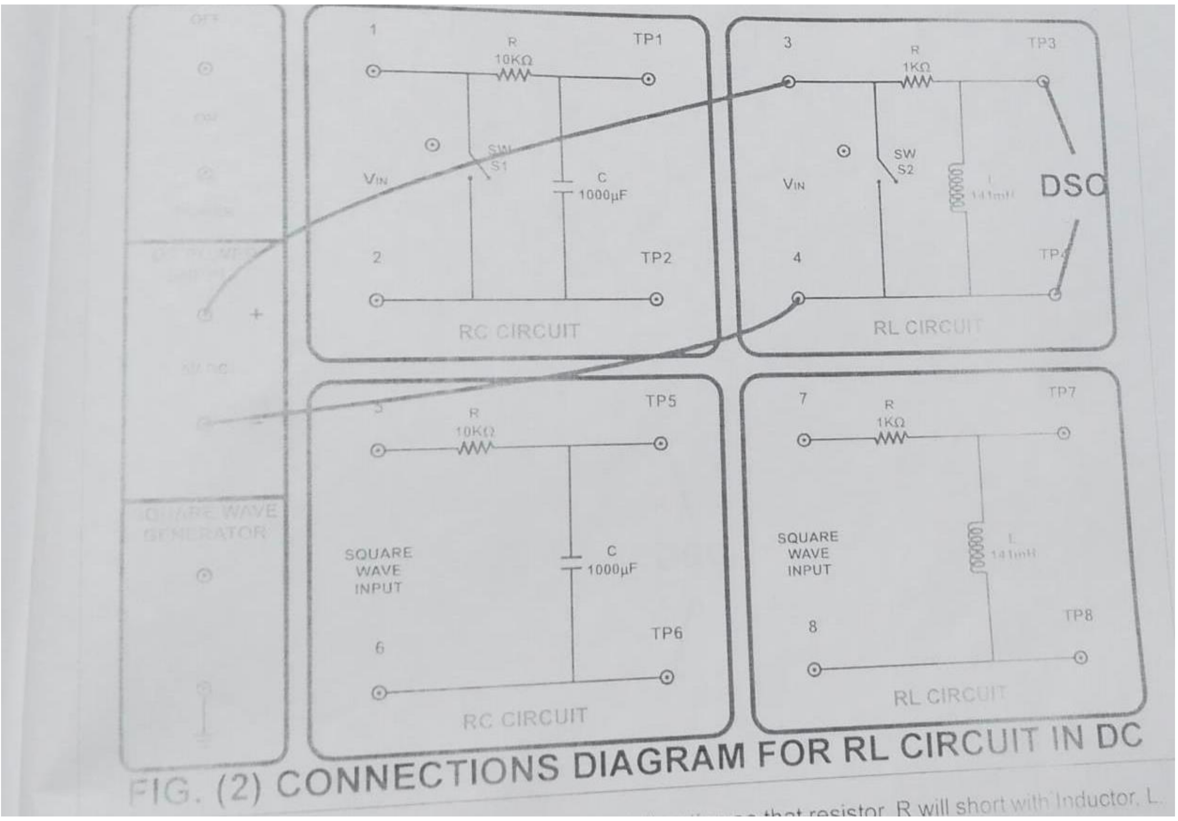


FIG. (2) CONNECTIONS DIAGRAM FOR RL CIRCUIT IN DC

PROCEDURE-

FOR RL CIRCUIT

1) Connect the circuit as shown as per connection diagram
2) Make sure that the toggle switch connected across the DC Supply is in downward position
3) Connect +5 V DC Power Supply to the input of RL Circuit i.e. connect +5 V socket (3) & GND socket to socket (4)
4) Now switch 'ON' the power switch of the trainer
5) Switch the toggle switch in upward direction so that DC Supply willconnect to the RL circuit
6) Connect DSO across inductor ie. across TP3 and TP4. Keep DSO at 200or 500 as Time Base
7) Observe the transient response (firstly sudden increase in voltage and then exponentially decaying) on DSO, Now immediately press

   RUN/STOP Switch of DSO to hold the response shown on the DSO screen

   8)Now switch the toggle switch in downward direction so that resistor, R will short with Inductor L

   9)Now observe the response till it (first sudden increase of voltage in negative direction and then exponentially rising towards reference level) reaches reference level of DSO

Calculations:

Theoretically,
Time Constant, TC = L/R where L=141 37mH, R=1K
Practically (on DSO screen),
In the charging circuit, one Time Constant is the time by which the inductor attains the 36.8% of Time Constant or Time required to decay to 36.8% of 5 V (i.e. 1.84 V).

FOR RC CIRCUIT

1) Connections were made as per connection diagram
2) Make sure that the toggle switch connected across the DC Supply is in downward position
3)Connect +5V DC Power Supply to the input of RC Circuit le connect +5Vterminal to Socket (1) and GND socket to socket (2)
4) Now switch ON the power switch of the Trainer

5) Switch the toggle switch in upward direction so that DC Supply will connectto the RC circuit
6) Connect DSO across Capacitor across TP1 & TP2. Keep DSO at 10 seconds ormore Time Base
7) Observe the Transient Response (exponentially rising) on DSO till the steady state (+5V DC Level) is achieved for 50 seconds
8) Now switch the toggle switch in downward direction so that resistor, R will short with capacitor C
9) Now observe the response (exponentially decaying) till it reaches reference level of DSO. Now immediately press RUNISTOP Switch of DSO to hold the response shown on the DSO screen

Calculations:

Theoretically. Time constant TC= R*C where R= 10K and C= 1000μFPractically on DSO screen

In the charging circuit. Time Constant is the time by which the capacitor attains the 63.2% of steady state voltage or final value (in our case +5V)

Time Constant or Time required to rise to 63.2% of 5 V (ie.3.16 V)=...........
In the discharging circuit Time Constant is time by which the capacitor discharge to 36.8% of its Steady state voltage (in our case, +5 V)

Time Constant or Time required to decay to 36.8% of 5V (i.e. 1.84 V)=........
Similarly, 2TC is the time required to achieve 86.5% of final or initial value ofvoltage
Practically, 2TC=
Theoretically, 2TC=..........

After 5TC, the voltage reach their final values which is also called steady state response
Practically, 5TC=
Theoretically, 5TC ....

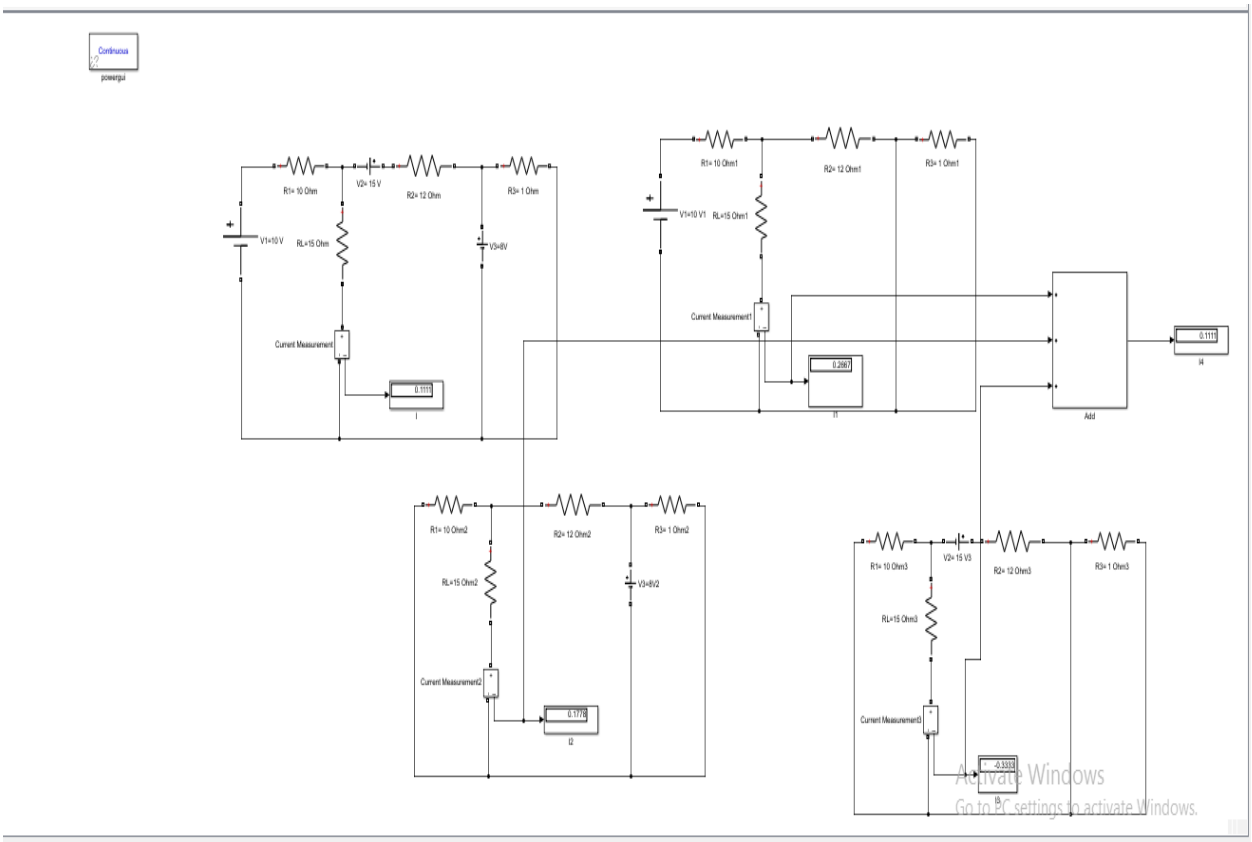
CONCLUSION- Hence the transient response of RL & RC circuit was beinganalysed.

EXPERIMENT NO -12(i)

AIM OF THE EXPERIMENT- To construct Superposition theorem using MATLAB software and compare the measurements

APPARATUS REQUIRED- MATLAB SOFTWARE 2018b

SIMUKINK DIAGRAM-



PROCEDURE-

1) Connections were done as per simulink diagram
2) Data were entered into the circuit parameters
3) The simulink model was being run using RUN command to display theresults at the display block

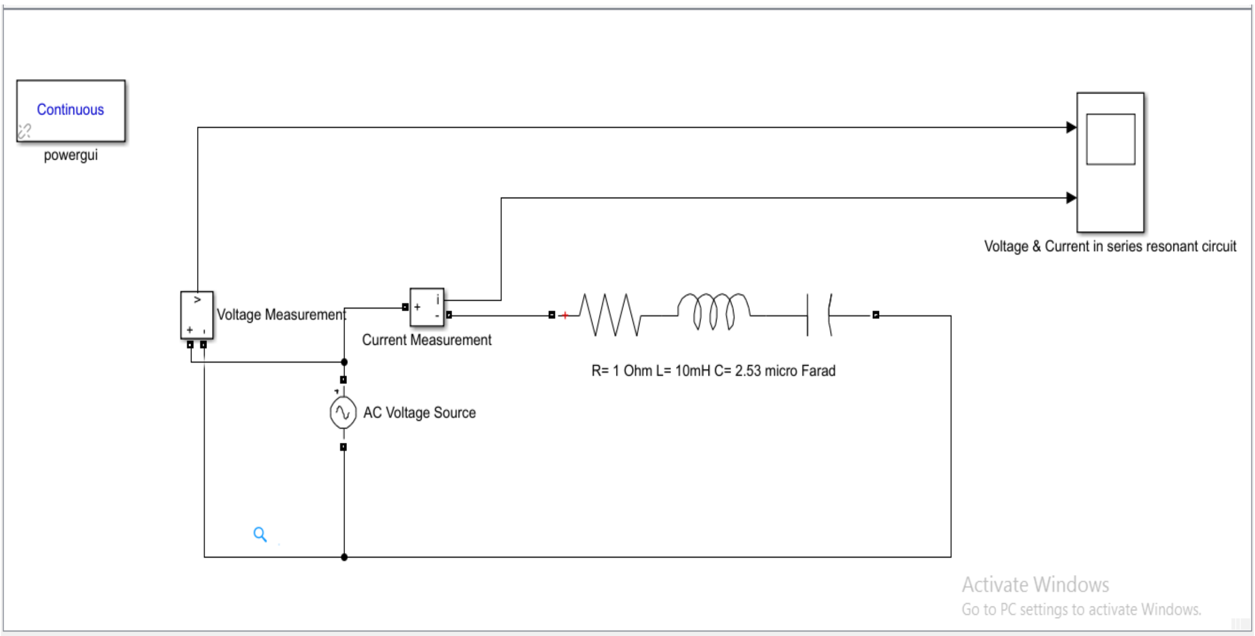
CONCUSION- Hence Superposition theorem using MATLAB software was beingconstructed and the output was being obtained successfully.

EXPERIMENT NO -12(ii)

AIM OF THE EXPERIMENT- To construct Series Resonant Circuit using MATLAB software and compare the measurements

APPARATUS REQUIRED- MATLAB SOFTWARE 2018b

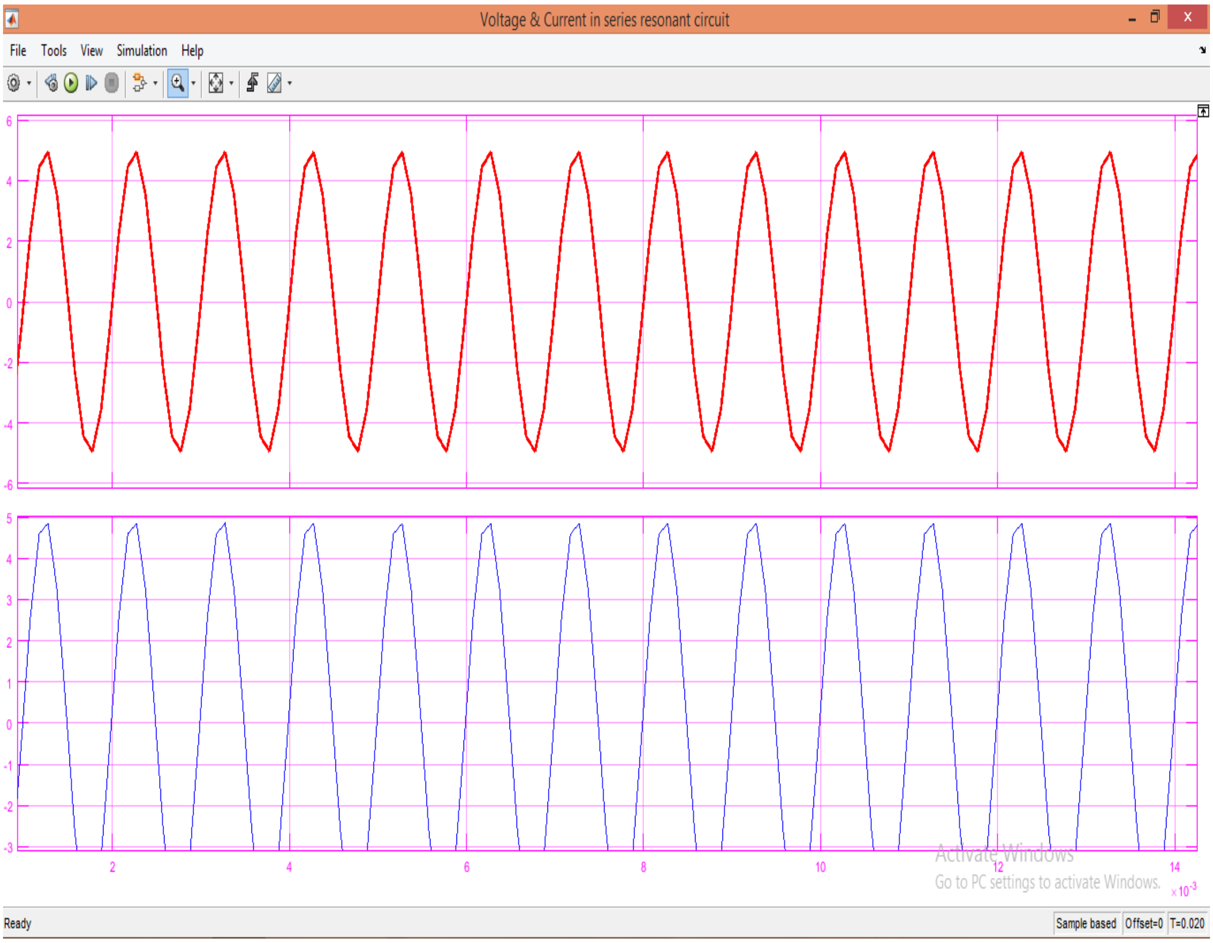
SIMUKINK DIAGRAM-



PROCEDURE-

1) Connections were done as per Simulink diagram
2) Data R= 1 Ω, C=2.53μF & L= 10 mH were entered into the circuirtparameters
3) Then the model was run using RUN command to obtain the output voltage & current waveform

SIMULINK OUTPUT WAVEFORM-



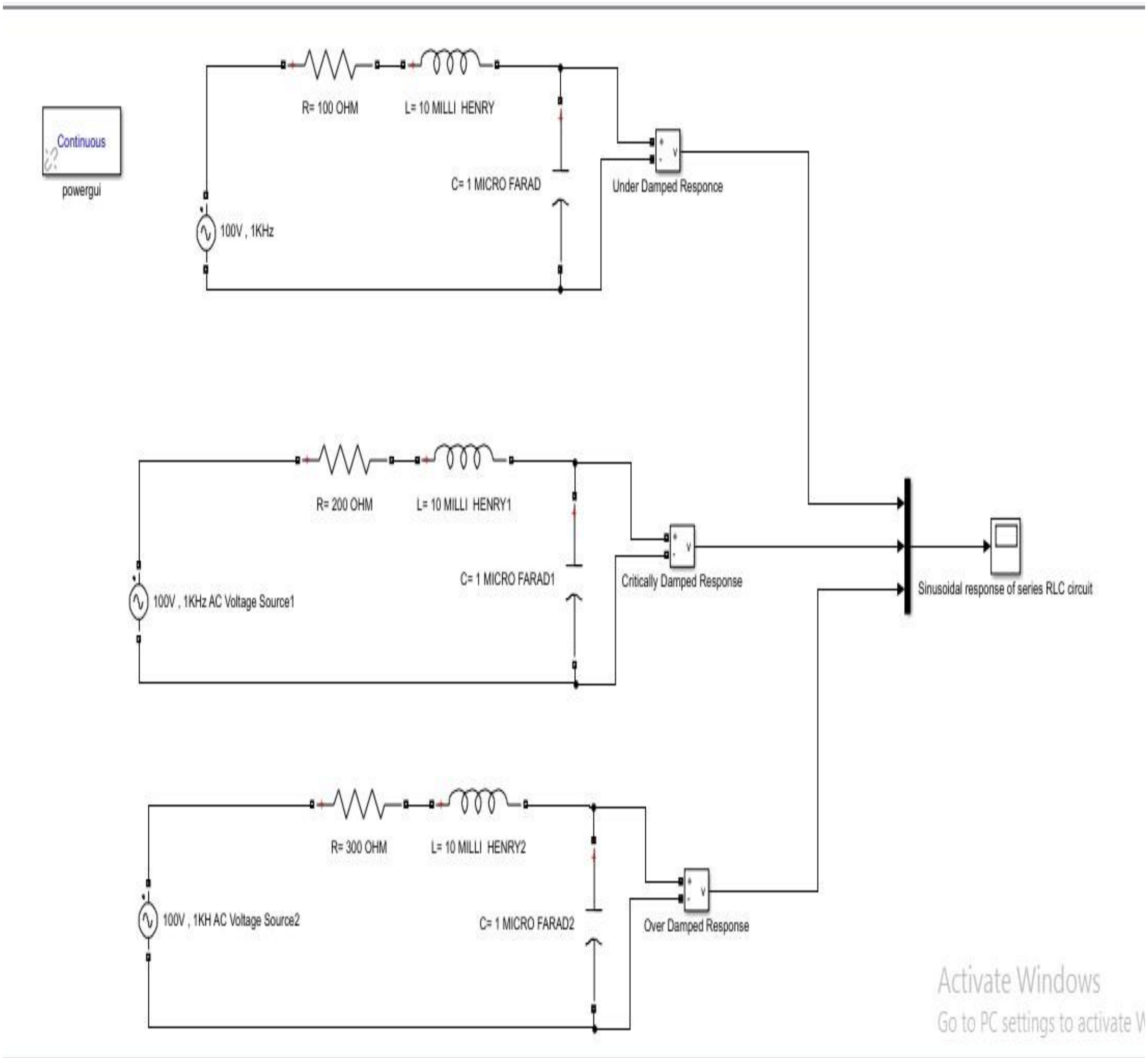
CONCLUSION- Hence Series Resonant Circuit using MATLAB software wasbeing constructed & output was being obtained successfully.

EXPERIMENT NO -12(iii)

AIM OF THE EXPERIMENT- To construct transient response in RLC series circuit using MATLAB software

APPARATUS REQUIRED- MATLAB SOFTWARE 2018b

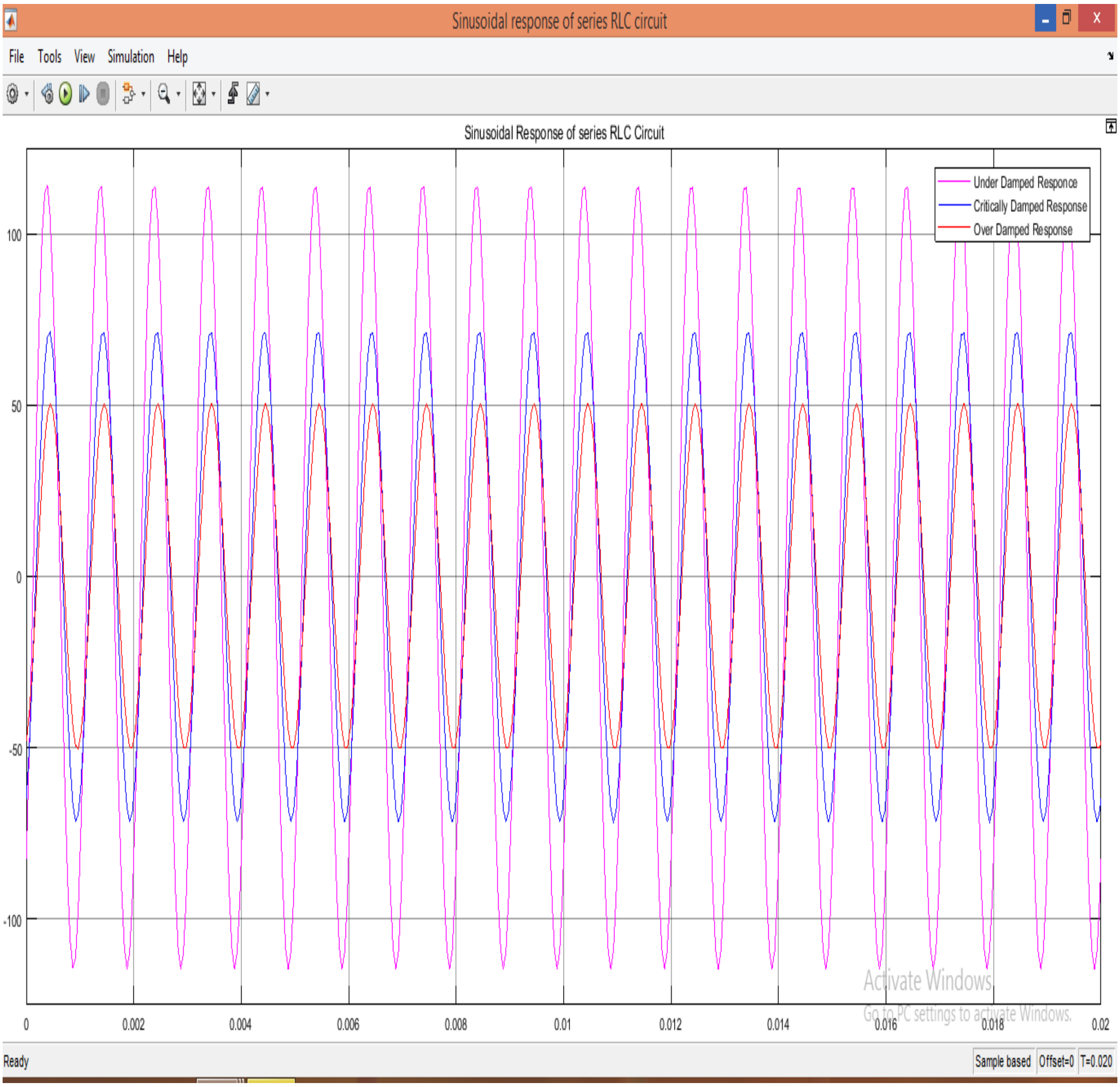
SIMUKINK DIAGRAM-



PROCEDURE-

1) Connections were done as per Simulink diagram
2) Data R= 100Ω, C=1μF & L= 10 mH were entered into the circuirtparameters for underdamped response
3) Data R= 200Ω, C=1μF & L= 10 mH were entered into the circuirtparameters for critically damped response
4) Data R= 300Ω, C=1μF & L= 10 mH were entered into the circuirtparameters for overdamped response
5) Then the model was run using RUN command to obtain the output response

SIMULINK OUTPUT RESPONSE-



CONCLUSION- Hence transient response in RLC series circuit using MATLAB software was being constructed and output was being obtained successfully.