SEMESTER – II

ELECTRICITY AND MAGNETISM PRACTICAL **L T P C**

17PHU211 **- - 2 1**

ANY SIX EXPERIMENTS

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.

2. Ballistic Galvanometer:

(i) Measurement of charge and current sensitivity

(ii) Measurement of CDR

(iii) Determine a high resistance by Leakage Method

(iv) To determine Self Inductance of a Coil by Rayleigh's Method.

3. To compare capacitances using De'Sauty's bridge.

4. Measurement of field strength B & its variation in a Solenoid (Determine dB/dx).

5. To study the Characteristics of a Series RC Circuit.

6. To study a series LCR circuit and determine its (a) Resonant Frequency, (b) Quality Factor
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q

8. To determine a Low Resistance by Carey Foster's Bridge.

9. To verify the Thevenin and Norton theorem

10. To verify the Superposition, and Maximum Power Transfer Theorem

REFERENCE BOOKS

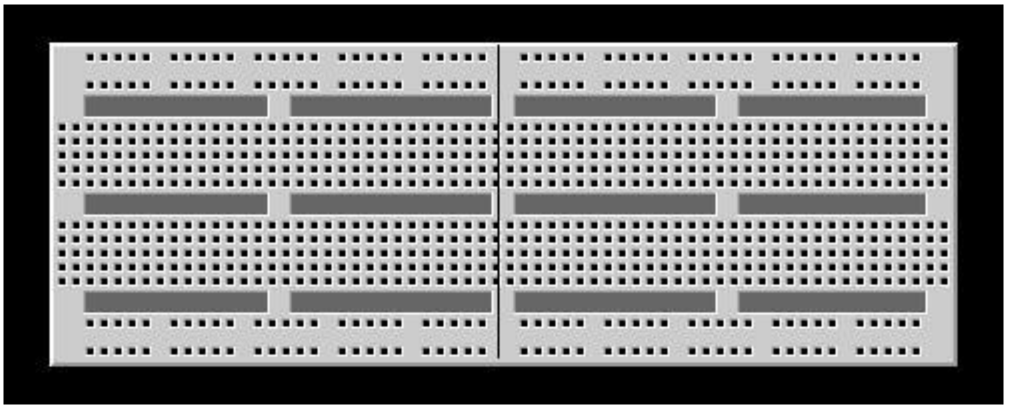
1. Advanced practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. Engineering practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
3. A Text Book of practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

IDENTIFICATION OF CIRCUIT COMPONENTS

Breadboards:

In order to temporarily construct a circuit without damaging the components used to build it, we must have some sort of a platform that will both hold the components in place and provide the needed electrical connections. In the early days of electronics, most experimenters were amateur radio operators. They constructed their radio circuits on wooden breadboards. Although more sophisticated techniques and devices have been developed to make the assembly and testing of electronic circuits easier, the concept of the breadboard still remains in assembling components on a temporary platform.

(a)



(b)

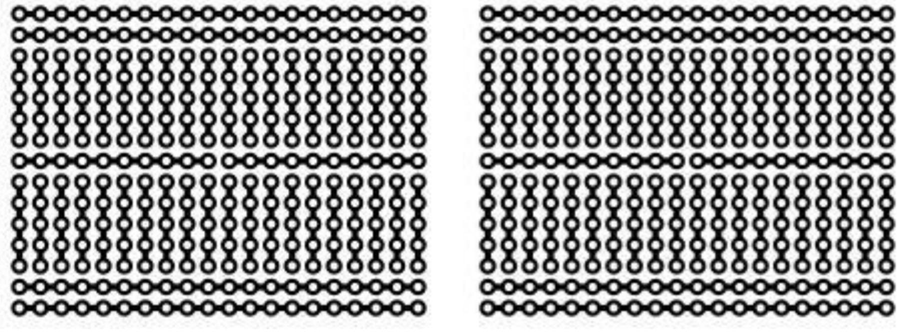


Fig. 1: (a) A typical Breadboard and (b) its connection details

A real breadboard is shown in Fig. 1(a) and the connection details on its rear side are shown in Fig. 1(b). The five holes in each individual column on either side of the central groove are electrically connected to each other, but remain insulated from all other sets of holes. In addition to the main columns of holes, however, you'll note four sets or groups of holes along the top and bottom. Each of these consists of five separate sets of five holes each, for a total of 25 holes. These groups of 25 holes are all connected together on either side of the dotted line indicated on Fig.1(a) and needs an external connection if one wishes the entire row to be connected. This makes them ideal for distributing power to multiple ICs or other circuits.

These breadboard sockets are sturdy and rugged, and can take quite a bit of handling. However, there are a few rules you need to observe, in order to extend the useful life of the electrical contacts and to avoid damage to components. These rules are:

- Always make sure power is disconnected when constructing or modifying your experimental circuit. It is possible to damage components or incur an electrical shock if you leave power connected when making changes.

- Never use larger wire as jumpers. #24 wire (used for normal telephone wiring) is an excellent choice for this application. Observe the same limitation with respect to the size of component leads.

- Whenever possible, use ¼ watt resistors in your circuits. ½ watt resistors may be used when necessary; resistors of higher power ratings should never be inserted directly into a breadboard socket.

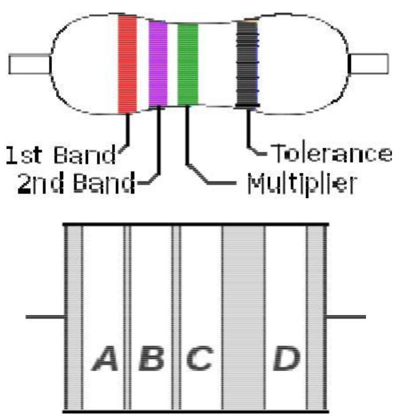
- Never force component leads into contact holes on the breadboard socket. Doing so can dam age the contact and make it useless.

- Do not insert stranded wire or soldered wire into the breadboard socket. If you must have stranded wire (as with an inductor or transformer lea d), solder (or use a wire nut to connect) the stranded wire to a short length of solid hookup wire, and insert only the solid wire into the breadboard.

If you follow these basic rules, your breadboard will last indefinitely, and your experimental components will last a long time.

Resistors

Most axial resistors use a pat tern of colored stripes to indicate resistance. A 4 band identification is the most commonly used color coding scheme on all resistors. It consists of four colored bands that are painted around the body of the resistor. Resistor values are always coded in ohms (Ω). The color codes are given in the following table in Fig. 1.



Band Color	Digit	Multiplier	Tolerance
Black	0	1	---
Brown	1	10	±1%
Red	2	100	±2%
Orange	3	1,000	±3%
Yellow	4	10,000	±4%
Green	5	100,000	---
Blue	6	1,000,000	---
Violet	7	10,000,000	---
Gray	8	100,000,000	---
White	9	---	---
Gold	---	0.1	±5%
Silver	---	0.01	±10%
None	---	---	±20%

Fig. 1: Color codes of Resistors

- band **A** is first significant figure of component value
- band **B** is the second significant figure
- band **C** is the decimal multiplier
- band **D** if present, indicates tolerance of value in percent (no color means 20%)

For example, a resistor with bands of *yellow, violet, red, and gold* will have first digit 4 (yellow in table below), second digit 7 (violet), followed by 2 (red) zeros: 4,700 ohms. Gold signifies that the tolerance is ±5%, so the real resistance could lie anywhere between 4,465 and 4,935 ohms.

Tight tolerance resistors may have three bands for significant figures rather than two, and/or an additional band indicating temperature coefficient, in units of ppm/K. For large power resistors and potentiometers, the value is usually written out implicitly as "10 k ", for instance.

Capacitors:

You will mostly use electrolytic and ceramic capacitors for your experiments.

Electrolytic capacitors

An **electrolytic capacitor** is a type of capacitor that uses an electrolyte, an ionic conducting liquid, as one of its plates, to achieve a larger capacitance per unit volume than other types. They are used in relatively high-current and low-frequency electrical circuits. However, the voltage applied to these capacitors must be polarized; one specified terminal must always have positive potential with respect to the other. These are of two types, axial and radial capacitors as shown in adjacent figure. The arrowed stripe indicates the polarity, with the arrows pointing towards the negative pin.

Fig. 2:Axial and Radial Electrolytic capacitors

Warning: connecting electrolytic capacitors in reverse polarity can easily damage or destroy the capacitor. Most large electrolytic capacitors have the voltage, capacitance, temperature ratings, and company name written on them without having any special color coding schemes.

Axial electrolytic capacitors have connections on both ends. These are most frequently used in devices where there is no space for vertically mounted capacitors.

Radial electrolytic capacitors are like axial electrolytic ones, except both pins come out the same end. Usually that end (the "bottom end") is mounted flat against the PCB and the capacitor rises perpendicular to the PCB it is mounted on. This type of capacitor probably accounts for at least 70% of capacitors in consumer electronics.

Ceramic capacitors are generally non-polarized and almost as common as radial electrolytic capacitors. Generally, they use an alphanumeric marking system. The number part is the same as for SMT resistors, except that the value represented is in pF. They may also be written out directly, for instance, 2n2 = 2.2 nF.

Fig. 3: Ceramic capacitors

Diodes:

A standard specification sheet usually has a brief description of the diode. Included in this description is the type of diode, the major area of application, and any special features. Of particular interest is the specific application for which the diode is suited. The manufacturer also provides a drawing of the diode which gives dimension, weight, and, if appropriate, any identification marks. In addition to the above data, the following information is also provided: a static operating table (giving spot values of parameters under fixed conditions), sometimes a characteristic curve (showing how parameters vary over the full operating range), and diode ratings (which are the limiting values of operating conditions outside which could cause diode damage). Manufacturers specify these various diode operating parameters and characteristics with "letter symbols" in accordance with fixed definitions. The following is a list, by letter symbol, of the major electrical characteristics for the rectifier and signal diodes.

RECTIFIER DIODES

DC BLOCKING VOLTAGE [V_R]—the maximum reverse dc voltage that will not cause breakdown.

AVERAGE FORWARD VOLTAGE DROP [$V_{F(AV)}$]—the average forward voltage drop across the rectifier given at a specified forward current and temperature.

AVERAGE RECTIFIER FORWARD CURRENT [$I_{F(AV)}$]—the average rectified forward current at a specified temperature, usually at 60 Hz with a resistive load.

AVERAGE REVERSE CURRENT [$I_{R(AV)}$]—the average reverse current at a specified temperature, usually at 60 Hz.

PEAK SURGE CURRENT [I_{SURGE}]—the peak current specified for a given number of cycles or portion of a cycle.

SIGNAL DIODES

PEAK REVERSE VOLTAGE [PRV]—the maximum reverse voltage that can be applied before reaching the breakdown point. (PRV also applies to the rectifier diode.)

REVERSE CURRENT [I_R]—the small value of direct current that flows when a semiconductor diode has reverse bias.

MAXIMUM FORWARD VOLTAGE DROP AT INDICATED FORWARD CURRENT [V_F@I_F]— the maximum forward voltage drop across the diode at the indicated forward current. REVERSE RECOVERY TIME [t_{rr}]—the maximum time taken for the forward-bias diode to recover its reverse bias.

The ratings of a diode (as stated earlier) are the limiting values of operating conditions, which if exceeded could cause damage to a diode by either voltage breakdown or overheating.

The PN junction diodes are generally rated for: MAXIMUM AVERAGE FORWARD CURRENT, PEAK RECURRENT FORWARD CURRENT, MAXIMUM SURGE CURRENT, and PEAK REVERSE VOLTAGE

Maximum average forward current is usually given at a special temperature, usually 25º C, (77º F) and refers to the maximum amount of average current that can be permitted to flow in the forward direction. If this rating is exceeded, structure breakdown can occur.

Peak recurrent forward current is the maximum peak current that can be permitted to flow in the forward direction in the form of recurring pulses.

Maximum surge current is the maximum current permitted to flow in the forward direction in the form of nonrecurring pulses. Current should not equal this value for more than a few milliseconds.

Transistors:

Transistors are identified by a Joint Army-Navy (JAN) designation printed directly on the case of the transistor. If in doubt about a transistor's markings, always replac e a transistor with one having identical markings, or consult an equipment or transistor man ual to ensure that an identical replacement or s ubstitute is used.

Example:

2	N	130	A
NUMBER OF JUNCTIONS FICATION(TRANSISTOR)	SEMICONDUCTOR	IDENTIFICATION NUMBER	FIRST MODI

There are three main series of transistor codes used:

- **Codes beginning with B (or A), for example BC108, BC478**

  The first letter B is for silicon, A is for germanium (rarely used now) . The second letter indicates the type; for example C means low power audio frequency; D means high power audio frequency; F means low power high frequency. The rest of the code identifies the particular transistor. There is no obvious logic to the numbering system. Sometimes a letter is added to the end (e.g BC108C) to identify a special version of the main type, for example a higher current gain or a different case style. If a project specifies a higher gain version (BC108C) it must be used, but if the general code is given (BC108) any transistor with that code is suitable.

- **Codes beginning with TIP, for example TIP31A**

  TIP refers to the manufa cturer: Texas Instruments Power transistor. The letter at the end identifies versions w ith different voltage ratings.
- **Codes beginning with 2N, for example 2N3053**

  The initial '2N' identifies the part as a transistor and the rest of the code identifies the particular transistor. There is no obvious logic to the numbering system.

TESTING A TRANSISTOR to determine if it is good or bad can be done with an ohmmeter or transistor tester. PRECAUTION S should be taken when working with transistors since they are susceptible to damage by electri cal overloads, heat, humidity, and radiation. TRANSISTOR LEAD IDENTIFICATION plays an important part in transistor maintenance because before a transistor can be tested or replaced, it s leads must be identified. Since there is NO s tandard method of identifying transistor leads, ch eck some typical lead identification schemes or a transistor manual before attempting to replace a transistor. Identification of leads for so me common case styles is shown in Fig. 6.

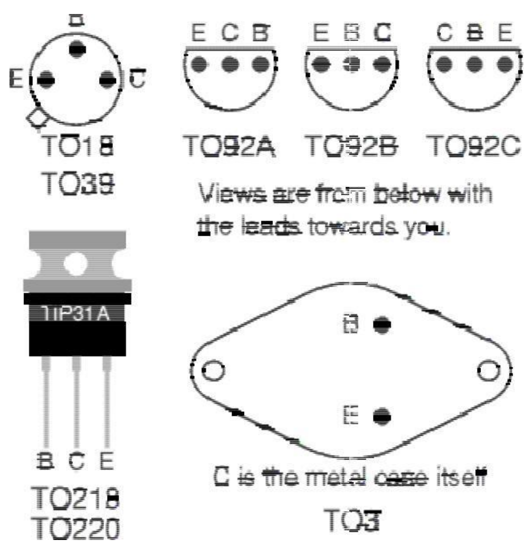


Fig. 6

Testing a transistor

Transistors are basically made u p of two *Diodes* connected together back-to-back (Fig. 7). We can use this analogy to determine whether a transistor is of the type PNP or NPN by testing

its Resistance between the three different leads, Emitter, Base and Collector.

Testing with a multimeter

Use a multimeter or a simple tester (battery, resistor and LED) to check each pair of leads for conduction. Set a digital multimeter to diode test and an analogue multimeter to a low resistance range.

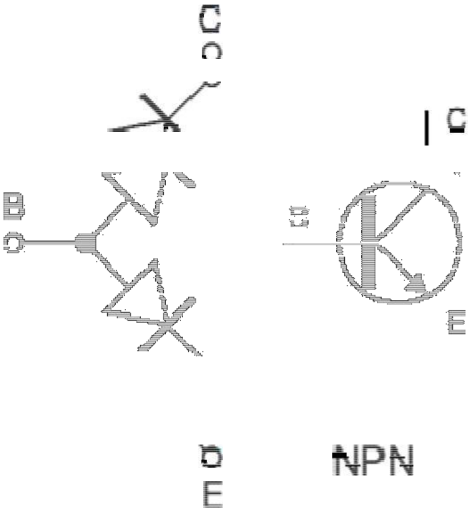


Fig. 7: Testing an NPN transistor

Test each pair of leads both ways (six tests in total):

- The **base-emitter (BE)** j unction should behave like a diode and conduct one way only.
- The **base-collector (BC)** junction should behave like a diode and c onduct one way only.
- The **collector-emitter (C E)** should not conduct either way.

The diagram shows how the junctions behave in an NPN transistor. The diode s are reversed in a PNP transistor but the same test procedure can be used.

Transistor Resistance Values for the PNP and NPN transistor types

Between Transistor	Terminals	PNP	NPN
Collector	Emitter	RHIGH	RHIGH
Collector	Base	RLOW	RHIGH
Emitter	Collector	RHIGH	RHIGH
Emitter	Base	RLOW	RHIGH
Base	Collector	RHIGH	RLOW
Base	Emitter	RHIGH	RLOW

1:

MULTIMETER MEASUREMENTS ON DC RESISTIVE CIRCUITS

AIM:

- Measurement of voltage, current, and resistance using the multimeters provided in the lab.
- Proficiency creating electrical circuits using resistors, wires, and power supplies.
- Verify theoretically calculated results using basic network laws.

APPARATUS:

Variable Power Supply, Fluke 45 Multimeter (Autoscale), and Fluke 8010A Multimeter

Four resistors with nominal values: 100 Ω□□ □□220 Ω , 470 Ω , 1k Ω, and 1.5k Ω

<u>Part A: Resistance Measurements</u>

PROCEDURE:

1. *Fluke 45 Multimeter Operation (Resistance Measurement)*

   Turn the meter ON and press □□□for Resistance Measurement. Insert two wires in the jacks labeled **V** Ω and **COM**. The multimeter can now be used to measure the resistance of a component connected between these two wires. Initially the meter reads OL M□□□because the resistance of an open circuit is infinity.

2. Measure the resistance of each of the four resistors and enter in the *Measured Value* column of the Data Sheet.

3. Determine the tolerance of each resistor as described on each component by the color of its band.
   A gold band represents 5%, a silver band represents 10%, and no band represents 20% tolerance. Enter in the *Tolerance* column of the Data Sheet.

4. Calculate the %Error for each resistor using the following formula:

   %Error = ((Nominal – Measured) / Nominal) x 100%

   Enter in the *%Error* column of the Data Sheet.

Part B: Voltage and Current Measurements

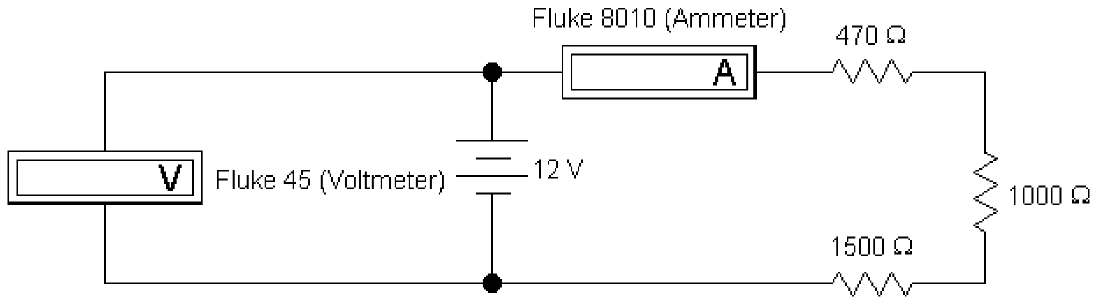
PROCEDURE:

1. *Fluke 45 Multimeter Operation (Voltmeter - Voltage Measurement)*
   Remove all connected wires. Turn the meter ON and press **V□□□□**for DC Voltmeter Mode. Insert a red wire in the jack labeled **VΩ** and a black wire in the jack labeled **COM**.
   Voltmeters have very high resistance that typically exceeds 1 M□□ **When making voltage measurements, make certain the voltmeter is connected in parallel with the circuit components across which voltage is measured.** A common mistake is to connect the voltmeter in series with the circuit components. This error would add a 1M□ series resistance to the circuit and drastically change the circuit parameters.

2. *Fluke 8010A Multimeter Operation (Ammeter - Current Measurement)*
   Remove all connected wires. Turn the meter ON and press **mA□□**for Ammeter Mode. Insert a red wire in the jack labeled **mA** and a black wire in the jack labeled **COMMON**. Select a current range dependent on the expected current measured. For this experiment the 20mA range is the most appropriate.
   Ammeters have very low resistance that typically is less then 0.5 □□ A common mistake is to connect the ammeter in parallel with the circuit components. **When making current measurements, make certain the ammeter is connected in series with the circuit components through which current is measured.** This error would effectively cause a short circuit and drastically change the circuit parameters.
   * **CAUTION: Never connect an ammeter directly across a power supply as it will cause a short circuit and be damaged.**

3. Power Supply Operation.
   Use the 0-20V Supply on the far right labeled POWER TWO. The red jack provides a voltage source to the circuit and the black jack is considered the 0V reference voltage. Always begin by turning the VOLTS knob to the counter-clockwise stop so that voltage begins at 0V. After the circuit has been connected, switch the power supply ON. Turn the VOLTS knob slowly Clockwise until the desired voltage is reached.
   The meter reading on the power supply should not be used as accuracy is not insured. Use a calibrated DMM to measure voltage, such as the Fluke 45 Multimeter.
   Current limit may be used to limit the current to a maximum amount.
   * **CAUTION:** Always turn off the power supply before connecting a circuit.

4. Connect the components as shown in the schematic shown in Figure 1.
   Figure 1



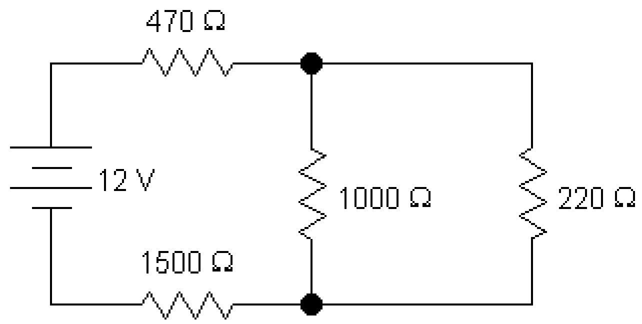
5. Turn ON the power supply and adjust it so that the output is 12V as measured on the Fluke 45. Measure the source current using the Fluke 8010A and enter the current value on the Data Sheet.

6. Remove the Voltmeter from the power supply and measure voltages across each of the resistors in the circuit. Enter the voltage values for each resistor on the Data Sheet

7. Now turn OFF the power supply.

8. Connect the 220□□resistor in parallel with the 1000□□resistor as shown by the schematic in Figure 2.

Figure 2



9. Turn ON the power supply and adjust it so that the output is 12V as measured on the Fluke 45. Measure the source current using the Fluke 8010A and enter the current value on the Data Sheet.

10. Measure the source current using the Fluke 1080A and enter the current value on the Data Sheet.

11. Measure the voltage across each of the four resistors of the circuit and the source voltage using the Fluke 45. Enter these voltage values on the Data Sheet.

12. Measure the current through each resistor by connecting the Fluke 1080A in series with each component of the circuit. Enter these current values on the Data Sheet.

Part C: Wheatstone bridge circuit

PROCEDURE:

1. Turn OFF the power supply and connect the components as shown in Figure 3.

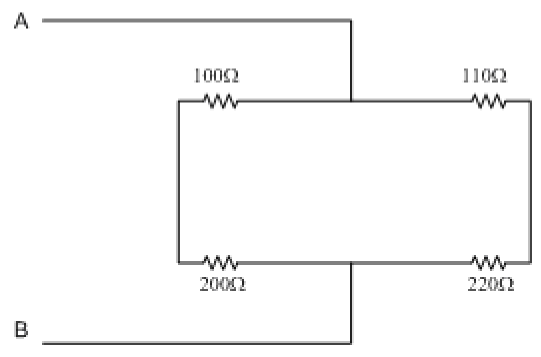


Figure 3.

2. Turn ON the power supply.
3. Measure the resistance across points A and B, using Fluke 45 Multimeter and enter into the Data Sheet.
4. Turn OFF the power supply and modify the circuit as in Figure 4:

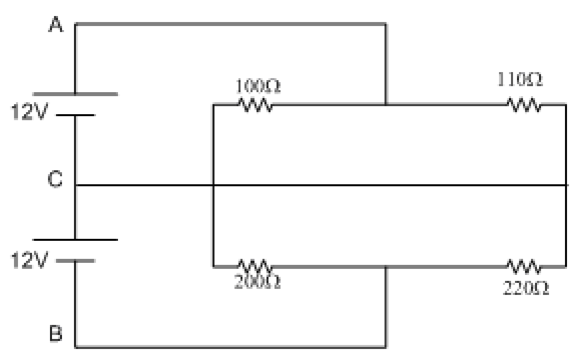


Figure 4

This circuit can be realized by using 2 sets of power supplies. Short the black terminals of both sets to form the common point C and use the red terminals as points A and B.

5. Turn ON the power supplies.
6. Measure voltages across points A and B, A and C, B and C, using Fluke 45 Multimeter and enter into the Data Sheet.
7. Turn OFF the power supply and modify the circuit as in Figure 5:

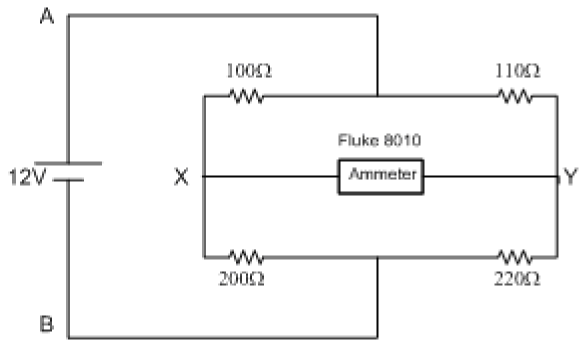


Figure 5

8. Turn ON the power supply.
9. Measure the current across the branch XY, using Fluke 8010A Multimeter and enter into the Data Sheet.

Data Sheet

Nominal Value (Ohms)	Color Code	Tolerance (%)	Measure Value (Ohms)	Percent Error (%)
220				
470				
1000				
1500				

Part A: Resistance Measurements

Part B: Voltage and Current Measurements

S.No	Measured
V_S	
I_S	
V_{470}	
I_{470}	
V_{1000}	
I_{1000}	
V_{1500}	
I_{1500}	
V_{220}	
I_{220}	

S.No	Calculated (Prelab)	Measured
V_S		
I_S		
V_{470}		
I_{470}		
V_{1000}		
I_{1000}		
V_{1500}		
I_{1500}		

Figure 1 Circuit Figure 2 Circuit

Part B: Voltage and Current Measurements

Figure 3 Circuit R_{AB}(Calculated in Prelab) = R_{AB}(Measured) =

Figure 4 Circuit V_{AB} = V_{BC} = V_{AC}=

Figure 5 Circuit I_{XY} (Calculated in Prelab) = I_{XY} (Measured) =

RESULT:

1. It is found that each resistor meet manufacturer specifications.
2. Calculate theoretical voltages and currents using the measured resistance values for the circuit of Figure 2. Tabulate your results. Comment on the correlation of measured and theoretical values? Explain possible sources of error.
3. Calculate the power supplied to the circuit from the power supply. Determine the power dissipation of each resistor in the circuit of Figure 2. Does your result satisfy the conservation of power law? Explain
4. Do the theoretical results agree with what is expected by Kirchoff's Laws? Explain
5. Did the voltages V_{470}, V_{1000}, V_{1500} in Figure 1, conform with the Voltage Divider
6. Did the currents I_{1000} and I_{220} in Figure 2, conform with the Current Divider
7. For figure 3, did the theoretical and measured value of R_{AB} match. If not comment.
8. For figure 4, which nodes can be considered a ground node.
9. For figure 5, why is the current I_{XY} nearly zero.

2. BALLISTIC GALVANOMETER

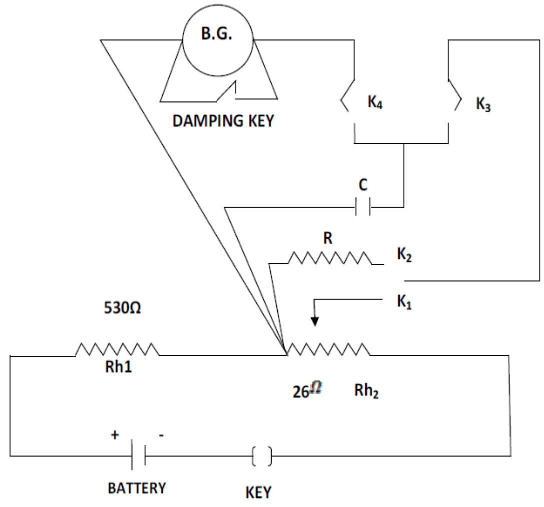
AIM: To determine the high resistance by method of leakage of charge using a Ballistic galvanometer

APPARTUS: A Ballistics galvanometer, a battery, two rheostats, a standard capacitor, stop watch, keys and a resistor whose resistance is to be determined.

FORMULA: The resistance R of the given resistor is given by

$$R = \frac{t}{C \cdot \log_e(\theta_0/\theta_t)} \text{ ohm}$$

DIAGRAM



EXPERIMENTAL SETUP

Where, t = time for which the charge on the capacitor is allowed to leak through the high resistance R

θ_0= first throw of the spot of light when the fully charged capacitor is discharged through the Ballistic Galvanometer.

θ_t= first throw of the spot of light when the fully charged capacitor is first discharged through the resistance R for a time t and then discharged through the Ballistics Galvanometer.

C= capacity of the given capacitor in farads.

PROCEDURE:

1. The spot of light of the Galvanometer is adjusted at zero of the scale
2. The connections are made as shown in the figure .Key k1 is inserted and key k3 is pressed. It will charge the condenser.
3. The key k3 is released and k4 is pressed. The first throw θ0 is noted. The value of throw θ0 is adjusted between 30 and 50 divisions with help of rheostat.
4. With the help of the damping key the motion of the spot is stopped. Key k3 is pressed again to charge the condenser
5. Key k1 is removed and k2 is closed. Key k3is pressed for a time t second, say 10 second. k4 is pressed after releasing k3. The first throw θt is noted.
6. For the same value of θ0 , θt is observed for two more values of t. 7. For a different set, the value of θ0is changed by varying the resistance of the rheostat and θt is observed for three different values of t.

OBSERVATIONS:

S.No.	Initial Throw in B.G θ°	Leakage time t (Sec)	Throw θ_t (degree)	θ_0/θ_t	$\log_e(\theta_0/\theta_t)$	$t/\log_e(\theta_0/\theta_t)$
1						
2						
3						
1						
2						
3						

Mean t/loge(θ0/θt) = (sec)

CALCULTION:

C= (μF) ; t /log e(θ0/θt)= (sec) ;R= ( )

RESULT:

Resistance of the given Resistor =…………

3. STUDY OF LCR RESONANT CIRCUIT

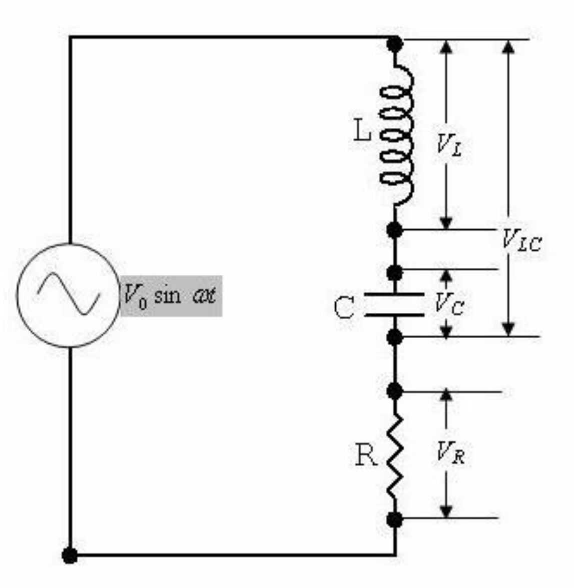
AIM:

(i) To study the behavior of a series LCR resonant circuit and to estimate the resonant frequency and Q-factor.

APPARATUS:

Inductor, Capacitor, Resistors, Function generator, Oscilloscope, Multimeter/LCR meter, Connecting wires, Breadboard

DIAGRAM:



PROCEDURE:

(I) Measuring V_R, V_{LC} and Φ_R, Φ_{LC}:

(a) Using the multimeter/LCR meter, note down all the measured values of the inductance, capacitance and resistance of the components provided. Also, measure the resistance of the inductor. Calculate the d.c. resistance of the circuit. Calculate the resonant frequency.

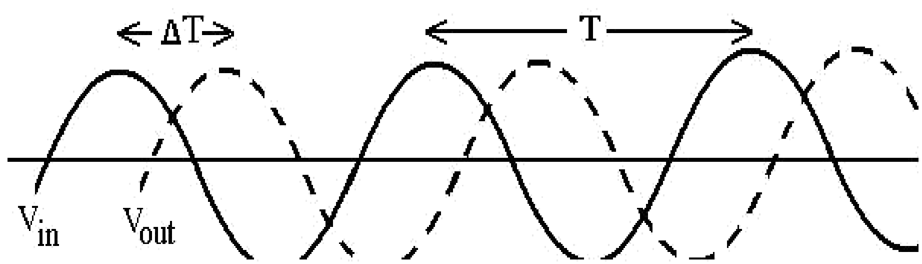
(b) Configure the circuit on a breadboard as shown in circuit diagram. Set the function generator **Range** in 20 KHz and **Function** in sinusoidal mode. Set an input voltage of 5V (peak-to-peak) with the oscilloscope probes set in X1 position. Set the function generator probe in X1 position.

(c) Feed terminals 1,4 in the circuit diagram to channel 1 and 3,4 to channel 2 of the oscilloscope to measure input voltage V_i and output voltage V_R, respectively. Note

that terminal 4 is connected to the ground pin of the function generator and oscilloscope.

(d) Vary the frequency in the set region slowly and record V_R and V_i (which may not remain constant at the set value, guess why?). Read the frequency from oscilloscope.

For each listed frequency, measure the phase shift angle Φ_R with proper sign as shown in the diagram below using the expression, $\boldsymbol{\varphi R}$ **(deg)** $= \dfrac{\Delta T}{T} \times \mathbf{3600}$.



(e) Replace the resistor with another value and repeat steps (c) and (d). No phase measurement is required.

(f) Now, interchange the probes of the function generator and oscilloscope, i.e. make terminal 1 as the common ground so that you will measure V_{LC} output between terminal 3 and 1 and V_i between 4 and 1. Repeat step-(d) to record V_{LC}, V_i and Φ_{LC}.

(II) Measuring V_L and V_C:

(a) Go back to the original circuit configuration you started with. Interchange R with L to measure V_i and V_L (see steps (c) and (d) of the previous procedure). Calculate V_L/V_i

for each frequency.

(b) Now, interchange the inductor with capacitor and measure V_i and V_C. Calculate V_C/V_i for each frequency.

OBSERVATIONS:

L = ________ mH, C = _______ μF, f_0 = = _________ kHz

$$f_0 = \frac{1}{2\pi\sqrt{LC}} = \text{--------kHz}$$

Internal resistance of inductor = _________

Output impedance of Function generator = __________

Table:1 **R_1 = _______**

Sl.No.	f (kHz)	V_i (V)	V_R (V)	V_R/V_i	V_R/V_i (Calculated)	Φ_R	Φ_R (Calculated)

Table:2 R_2 = _______

Sl.No.	Frequency (kHz)	Vi (V)	VR (V)	V_R/V_i	V_R/V_i (Calculated)

Table:3 R_1 = _______

Sl.No.	Frequency, f (kHz)	V_i (V)	VLC (V)	V_{LC}/V_i	V_{LC}/V_i (Calculated)	ΦLC (deg)	Φ_{LC} (deg) (Calculated)

Table:4 R_1 = _______

Sl.No.	f (kHz)	V_i (V)	V_L (V)	V_L/V_i

Table: R_1 = _______

Sl.No.	f (kHz)	Vi (V)	VC (V)	V_C/Vi

Graphs:

(a) Plot the observed values of V_R/V_i, V_{LC}/V_i, Φ_R and Φ_{LC} versus frequency. Estimate the resonant frequency.

(b) Plot V_R/V_i versus frequency for both the resistors on the same graph-sheet and compare their behavior. Estimate the Q-factor in each case and compare with calculated values.

(c) Plot V_L/V_i and V_C/V_i versus frequency on the same graph-sheet and estimate the resonant frequency from the point of intersection and compare with other estimations.

RESULTS:

1) The effective resonant frequency is found to be = …..….. Hz
2) The Q – factor of LCR resonant circuit is ………

4.VERIFICATION OF SUPERPOSITION THEOREM

AIM:

To verify the superposition theorem for the given circuit.

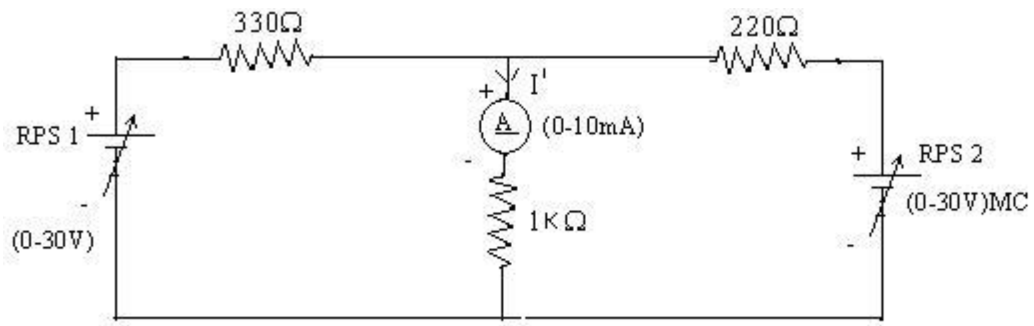
APPARATUS

Sl.No.	Apparatus	Range	Quantity
1	RPS (regulated power supply)	(0-30V)	2
2	Ammeter	(0-10mA)	1
3	Resistors	1k□, 330□, 220□	3
4	Bread Board	--	--
5	Wires	--	Required

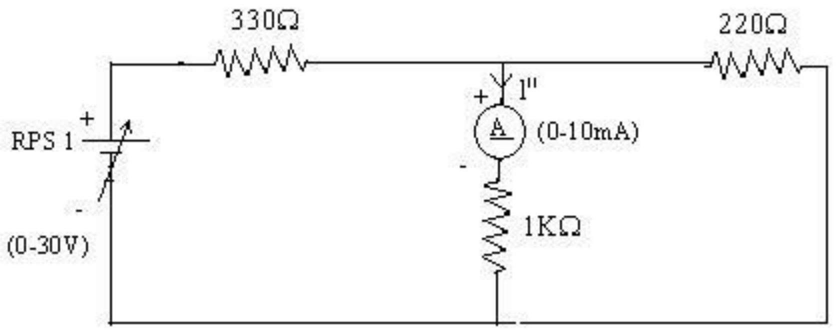
PROCEDURE:

1. Give the connections as per the diagram.
2. Set a particular voltage value using RPS_1 and RPS_2 & note down the ammeter reading
3. Set the same voltage in circuit I using RPS_1 alone and short circuit the terminals and note the ammeter reading.
4. Set the same voltage in RPS_2 alone as in circuit I and note down the ammeter reading.
5. Verify superposition theorem.

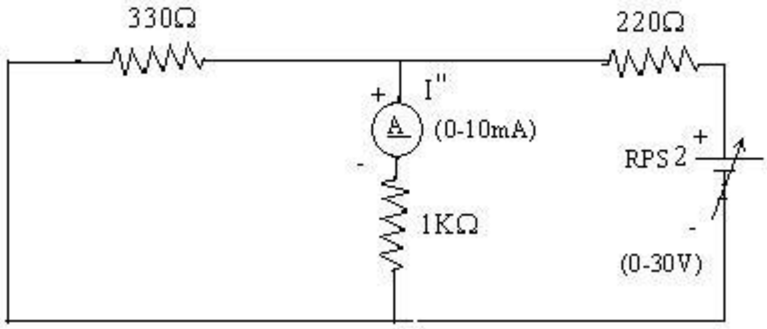
DIAGRAM



CIRCUIT - 1



CIRCUIT - 2



CIRCUIT - 3

OBSERVATION:

Theoretical Values

	RPS		Ammeter Reading (I) mA
	1	2	
Circuit – 1	10 V	10 V	I =
Circuit – 2	10 V	0 V	I’=

Circuit – 3	0 V	10 V	I”=

I = I’ □ I” = 8.83

Practical Values

	RPS		Ammeter Reading (I) mA
	1	2	
Circuit – 1	10 V	10 V	I =
Circuit – 2	10 V	0 V	I’=
Circuit – 3	0 V	10 V	I”=

I = I’ - I” = …….. mA

RESULT:

Superposition theorem have been verified theoretically and practically.

5.VERIFICATION OF MAXIMUM POWER TRANSFER THEOREM

AIM:

To verify maximum power transfer theorem for the given circuit

APPARATUS:

Sl.No.	Apparatus	Range	Quantity
1	RPS	(0-30V)	1
2	Voltmeter	(0-10V) MC	1
3	Resistor	1KΩ , 1.3KΩ , 3Ω	3
4	DRB	--	1
5	Bread Board & wires	--	Required

Precautions:

1. Voltage control knob of RPS should be kept at minimum position.
2. Current control knob of RPS should be kept at maximum position.

PROCEDURE:

Circuit – I

1. Connections are given as per the diagram and set a particular voltage in RPS.
2. Vary R_L and note down the corresponding ammeter and voltmeter reading.
3. Repeat the procedure for different values of R_L & Tabulate it.
4. Calculate the power for each value of R_L.

To find V_{TH}:

5. Remove the load, and determine the open circuit voltage using multimeter (V_{TH})

To find R_{TH}:

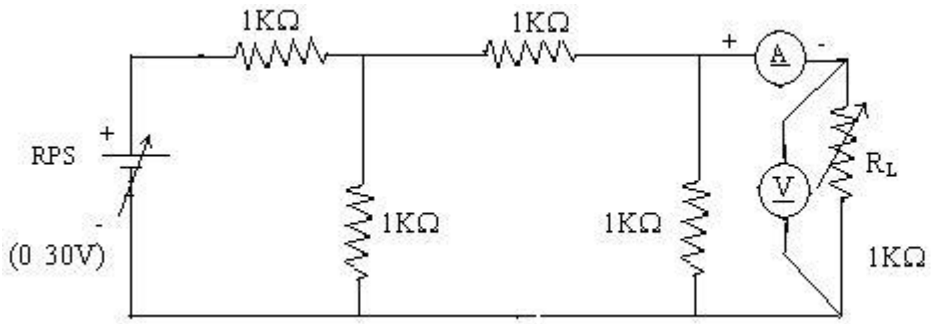
6. Remove the load and short circuit the voltage source (RPS).
7. Find the looking back resistance (R_{TH}) using multimeter.

Equivalent Circuit:

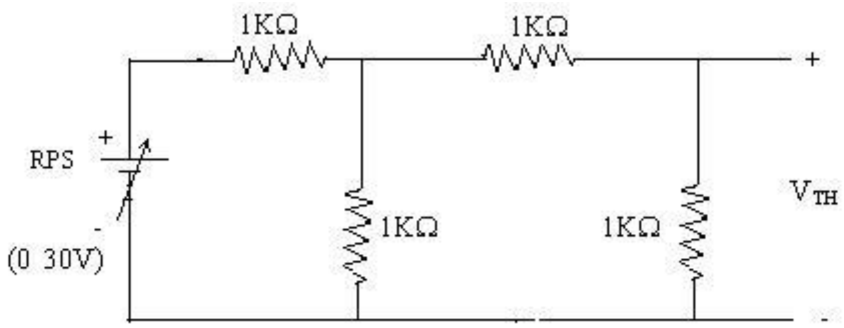
8. Set V_{TH} using RPS and R_{TH} using DRB and note down the ammeter reading.
9. Calculate the power delivered to the load ($R_L = R_{TH}$)
10. Verify maximum transfer theorem.

DIAGRAM

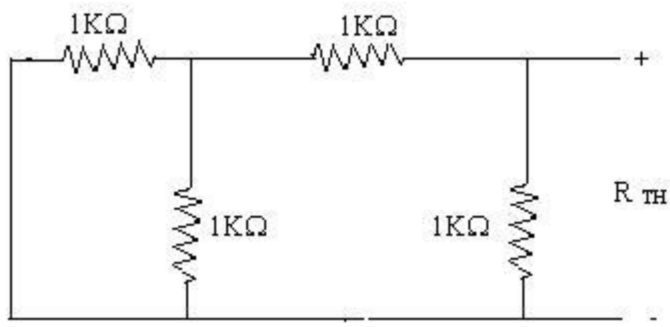
Circuit - 1



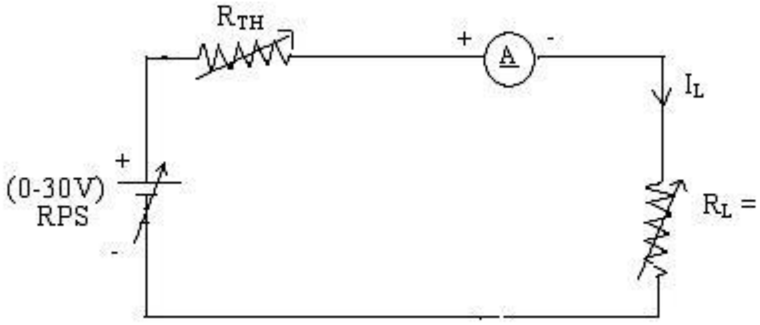
To find V_{TH}



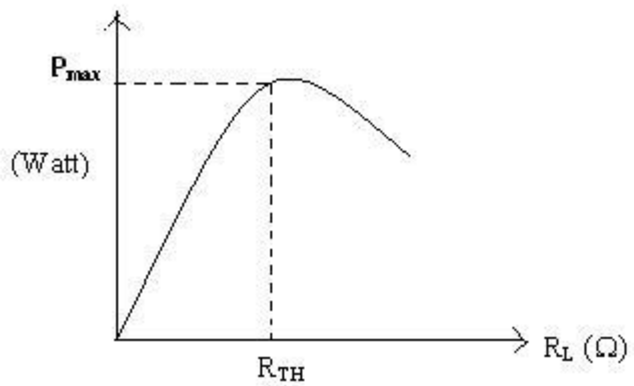
To find R_{TH}



Thevenin's Equation Circuit



Power V_S R_L



OBSERVATION

Circuit – I

Sl.No.	RL (ΩH)	I (mA)	V(V)	P=VI (watts)
1	200			
2	400			
3	600			
4	800			
5	1200			
6	1300			
7	1400			
8	1500			

To find Thevenin's equivalent circuit

	V_{TH} (V)	R_{TH} (Ω)	I_L (mA)	P (milli watts)
Theoretical Value	2002			
Practical Value	2			

CALCULATIONS:

RESULT:

Thus maximum power theorem was verified both practically and theoretically

6.VERIFICATION OF THEVENIN'S THEOREM

AIM:

To verify Thevenin's theorem and to find the full load current for the given circuit.

APPARATUS:

Sl.No.	Apparatus	Range	Quantity
1	RPS (regulated power supply)	(0-30V)	2
2	Ammeter	(0-10mA)	1
3	Resistors	1KΩ , 330Ω	3,1
4	Bread Board	--	Required
5	DRB	--	1

Precautions:

1. Voltage control knob of RPS should be kept at minimum position.
2. Current control knob of RPS should be kept at maximum position

PROCEDURE:

1. Connections are given as per the circuit diagram.
2. Set a particular value of voltage using RPS and note down the corresponding ammeter readings.

To find V_{TH}

3. Remove the load resistance and measure the open circuit voltage using multimeter (V_{TH}).

To find R_{TH}

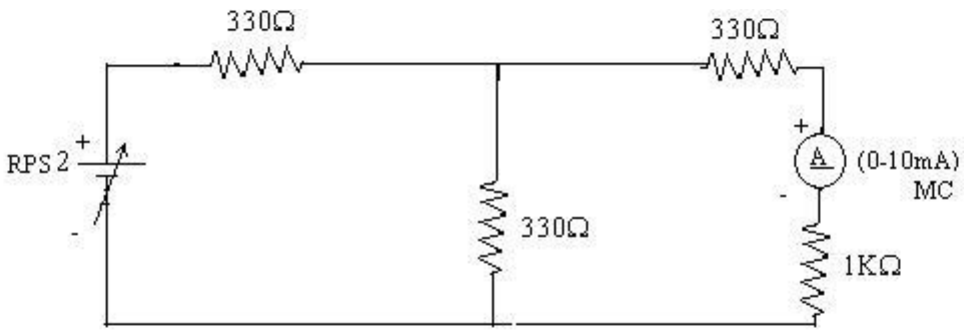
4. To find the Thevenin's resistance, remove the RPS and short circuit it and find the R_{TH} using multimeter.
5. Give the connections for equivalent circuit and set V_{TH} and R_{TH} and note the corresponding ammeter reading.
6. Verify Thevenins theorem.

Theoretical and Practical Values

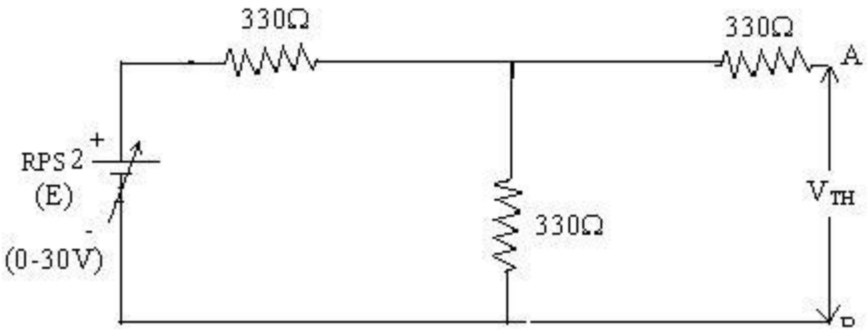
	E(V)	V_{TH}(V)	$R_{TH}(\Omega)$	I_L (mA)	
				Circuit - I	Equivalent Circuit
Theoretical	10	5	495	3.34	3.34
Practical	10	4.99	484	3.3	3.36

DIAGRAM:

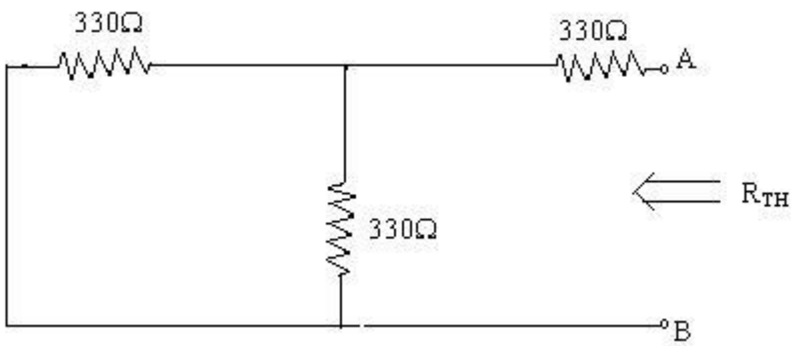
Circuit - 1 : To find load current



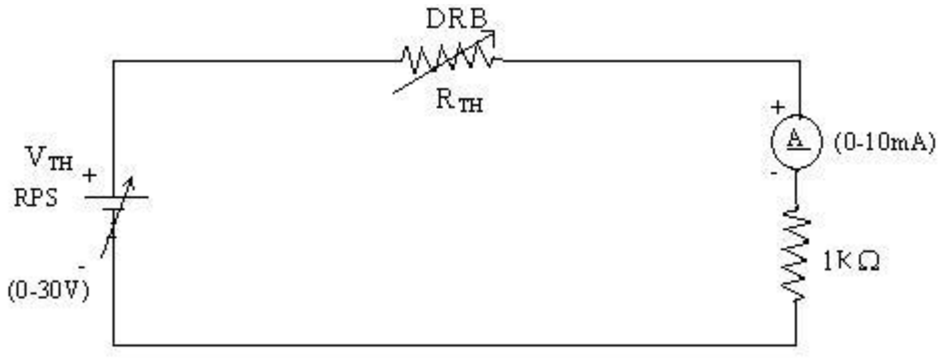
To find V_{TH}



To find R_{TH}



Thevenin's Equivalent circuit:



CALCULATIONS:

RESULT:

Hence the Thevenin's theorem is verified both practically and theoretically

6.VERIFICATION OF NORTON'S THEOREM

AIM:

To verify Norton's theorem for the given circuit.

APPARATUS:

Sl.No.	Apparatus	Range	Quantity
1	Ammeter	(0-10mA) MC (0-30mA) MC	1 1
2	Resistors	330, 1K□	3,1
3	RPS	(0-30V)	2
4	Bread Board	--	1
5	Wires	--	Required

Precautions:

1. Voltage control knob of RPS should be kept at minimum position.
2. Current control knob of RPS should be kept at maximum position.

PROCEDURE:

1. Connections are given as per circuit diagram.

2. Set a particular value in RPS and note down the ammeter readings in the original circuit.

To Find I_N:

3. Remove the load resistance and short circuit the terminals.
4. For the same RPS voltage note down the ammeter readings.

To Find R_N:

5. Remove RPS and short circuit the terminal and remove the load and note down the resistance across the two terminals.

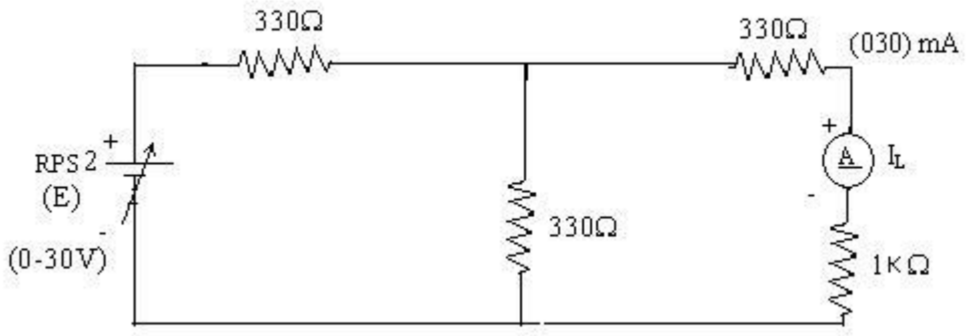
Equivalent Circuit:

6. Set I_N and R_N and note down the ammeter readings.

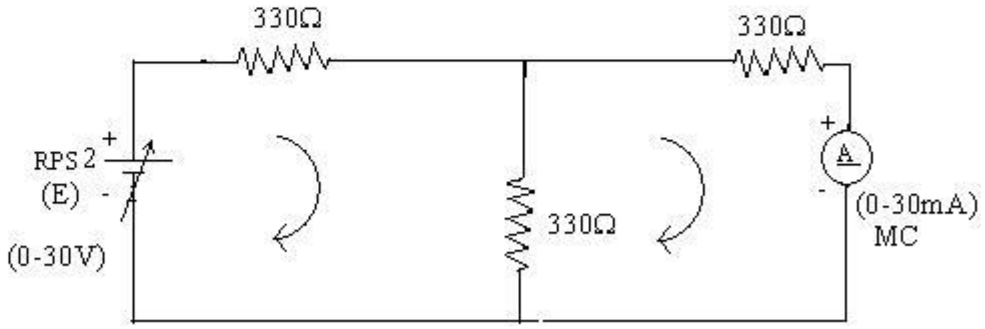
7. Verify Norton's theorem.

DIAGRAM

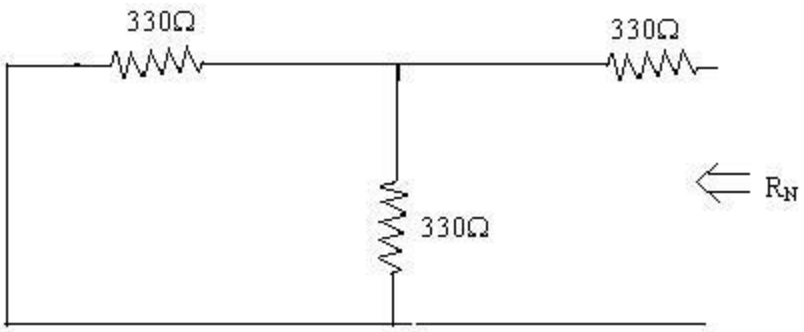
To find load current in circuit 1:



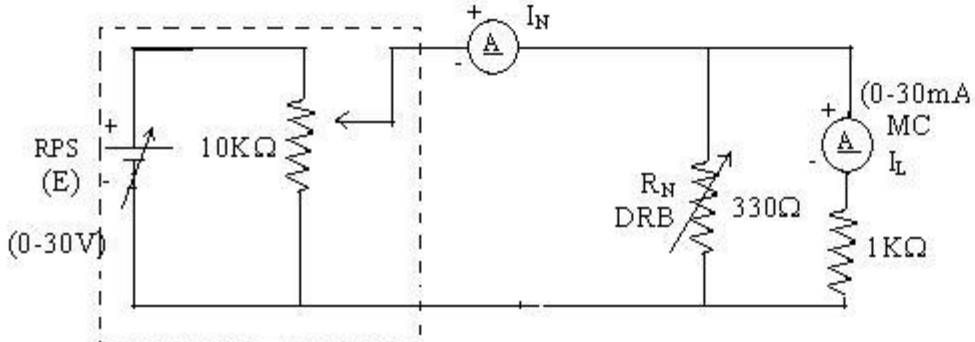
To find I_N



To find R_N



Norton's equivalent circuit



Theoretical and Practical Values

	E (volts)	**I_N (mA)**	**R_N (□)**	**I_L (mA)**	
				Circuit - I	**Equivalent Circuit**
Theoretical Values	10				
Practical Values	10				

CALCULATIONS:

RESULT:

Norton’s was verified practically and theoretically