Experiment No : 06

Experiment Name : Verification of thevenin's theorem

Required tools :

a) Four Rheostats
b) DC supply
c) Multi meter
d) Ammeter
e) There are three SPST switches.

Theory :

It is often desirable in circuit analysis to study the effect of changing a particular branch element while all other branches and all the sources in the circuit remain unchanged. Thevenin's theorem is a technique to this end and it reduces greatly the ammount of computations which we have to do each time a change is made. using thevenin's theorem the given circuit excepting the particular branch to be studied is reduced to the simplest equivalent circuit possible and then the branch to be changed is connected across the equivalent circuit.

The thevenin's theorem states that any two terminal linear bilateral network containing sources and passive elements can be replaced by an equivalent circuit consist of a voltage source, V_{th} in series a resistor R_{th} where V_{th} = the open circuit voltage V_{oc} at the two terminals A and B, R_{th} = the resistance looking into the terminals A and B of the network with all sources removed.

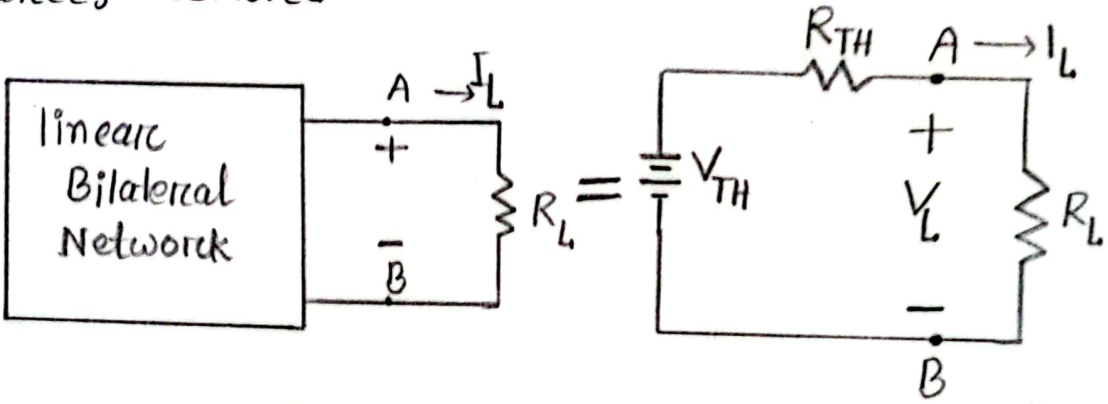

Figure-1: linear Bilateral connection.

There are sevel methods for determining thevenin resistance R_{TH}. An attractive method is to-

1. Determine the open circuit voltage.
2. Determine the short circuit current I_{sc} and calculate R_{th} as shown in figure and equation-

$$R_{TH} = \frac{V_{oc}}{I_{sc}}$$

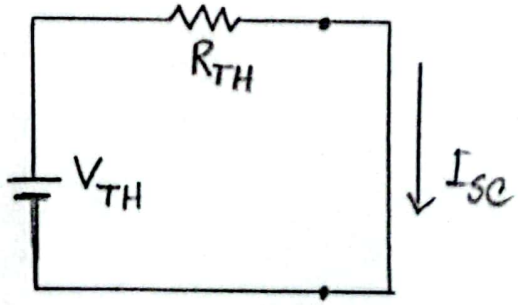

Figure-2: Short circuit

Experimental circuit :

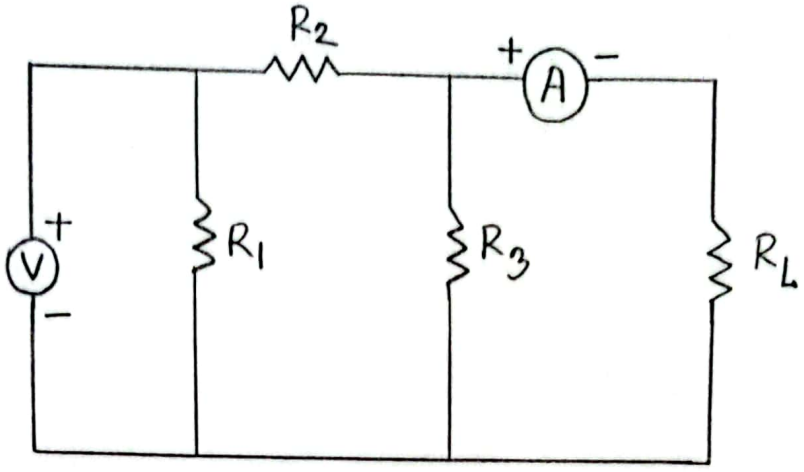

Figure - 3 : Verification of thevenin theorem (with R_L connection) (actual circuit)

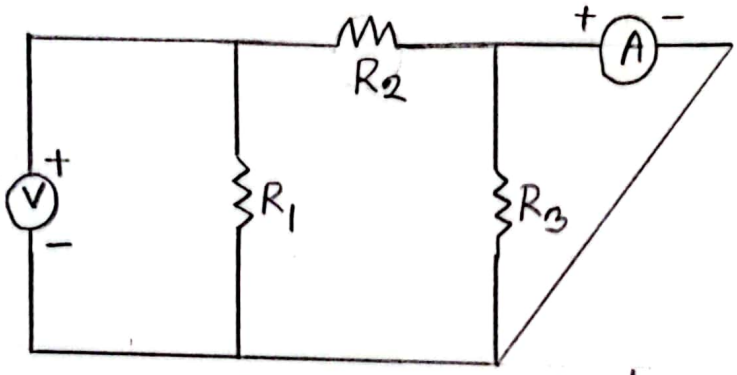

Figure -4 : Verification of thevenin theorem (without R_L connection) (thevenin equivalent circuit)

Session detail :

For original circuit :

1. Arrange the original circuit as shown in figure-3 . Apply 6V dc from dc power supply.

2. Messure V_L, I_L from-there three values of R_L and record the data in the table.

Finding thevenin's Equivalent circuit:

3. Remove the load resistance R_L and find the open circuit voltage between terminals A and B. The voltage $V_{TH} = V_{oc}$.

4. place a short circuit between terminals A and B and find the short circuit current I_{sc}. Devide the open circuit voltage by the short circuit current to find the thevenin resistance R_{TH}.

For thevenin circuit:

construct the thevenin's equivalent circuit setting the power supply at V_{TH} volts and the rheostat at R_{TH} ohms. Now measure the load current I_L and the load voltage V_L for the voltage values of R_L determined in step-2. compare these values with previous values.

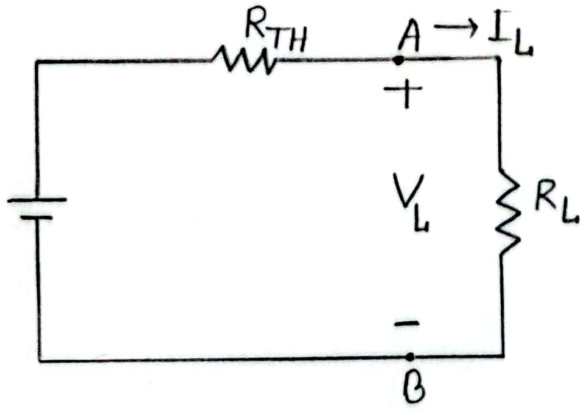

Figure-5 : Thevenin equivalent circuit.

Table for Experimental data:

Load	Thevenin equivalent circuit		original circuit		Errors	
R_L (KΩ)	V_L(V)	I_L(mA)	V_L'(V)	I_L'(mA)	V_L	I_L
2.94	3.8	1.22	3.6	1	0.2	0.22
2.94	5.7	1.85	6.1	2	0.4	0.15

Here, $V_{TH} = V_{OC} = 3.8$

$I_{SC} = 23.5\ mA$

$= 0.0235\ A$

$$R_{TH} = \frac{V_{TH} \text{ or } V_{OC}}{I_{SC}}$$

$= 161.70$

$$I_L = \frac{V_{TH}}{R_{TH} + R_L}$$

$= 1.22$

Post lab exercise:

1. Find theoretically the thevenin equivalent circuit for the values R_1, R_2, R_3 and V_S recorded in table.

From recorded in table we get.

$R_1 = 220\Omega$

$R_2 = 100\Omega$

$R_3 = 470\Omega$

$V_S = 6V$

2. Define unilateral, bilateral and equivalent circuit.

unilateral circuit:

In unilateral circuits, we see that, the property of circuit changes with the change of direction of supply voltage or current. It is allows the current to flow only in one direction. examp diode, transistor.

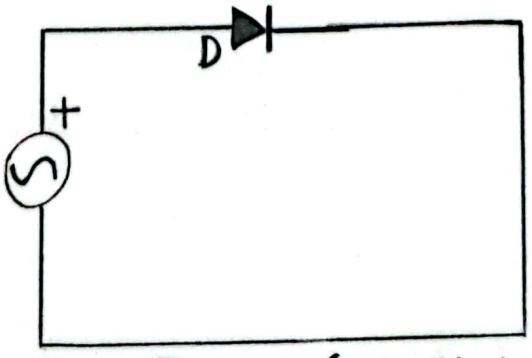

Figure-6: Unilateral circuit (Diode rectifier)

Bilaterral circuit:

A bilaterral circuit is a circuit that exhibits its properties equally in their either direction. It is one in which the relation between current and voltage do not change in either direction in the circuit.

example: Resistance, Inductance, capacitance.

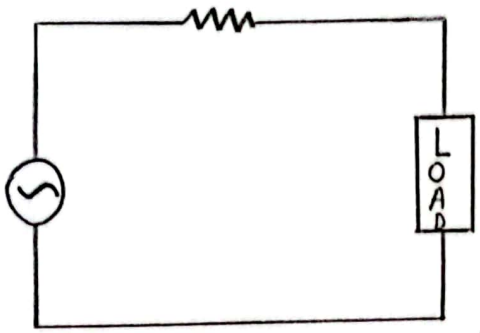

Figure-7: Bilateral circuit

equivalent circuit:

An equivalent circuit is a type of electrical circuit that is a simplified representation of more complex electrical circuit. It can take a complex circuit with many different sources of voltages, currents and resistances.

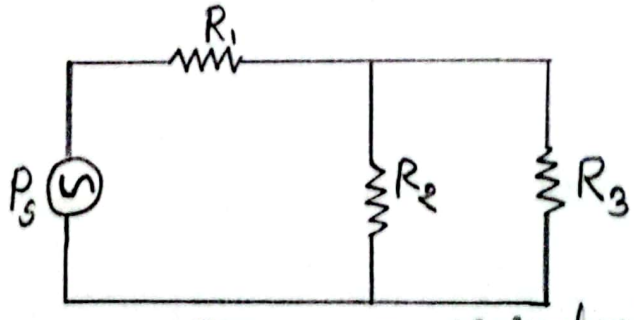

Figure-8: equivalent circuit

3. Describes other methods for determining thevenin resistance.

The different methods of finding thevenin's resistance or internal impedance are as follows:

- For independent source – It is the most common method.
- For dependent source –

For calculating the internal impedance of the dependent source in addition to or in the absence of independent source.

- **1st method:**

Find open-circuit voltage, V_{oc} across the load terminals by the conventional method either by mesh or nodal analysis.

Find short circuit current, I_{sc} through the shorted terminals.

$$R_{TH} = \frac{V_{oc}}{I_{sc}}$$

- **2nd method:** Here, we apply a DC driving voltage Vdc at the open circuited load terminals. when the voltage is applied by the DC supply,

DC driving current i_{dc} starts flowing in the circuit. This is because of the application of the V_{dc}.

$$R_{TH} = \frac{V_{dc}}{i_{dc}}$$

Hence, this is all about methods of finding R_{TH}.

4. Mention the advantages of using thevenin methods or theorem.

- Thevenin theorem is used to determine the current of a specific segment of the network.
- It reduces the complex circuit to a single circuit via a sighle source of emf.
- Enables us to view the action of the output part directly.