CSE 122 LAB 4

North East University Bangladesh

Department of CSE

Course no: CSE 122

Experiment no: 04

Experiment Name: Verification of Superposition and Thevenin Theorem

CAUTIONS:

1. **Don't switch on the supply of the circuit until you have verified the circuit carefully**
2. **Take readings of apparatus carefully**
3. **Take care of any bare circuit elements in energized condition**
4. **Never try to touch bare live wires**

Part A: Verification of Superposition Principle

Objective

To verify experimentally the Superposition theorem this is an analytical technique of determining currents in a circuit with more than one emf source.

Theory

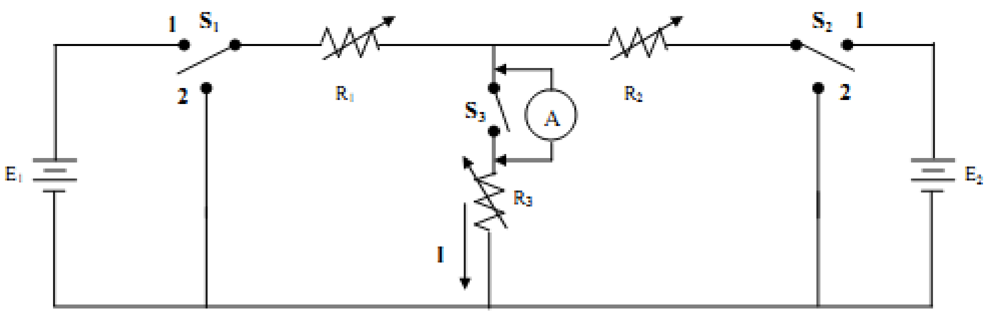
In a linear circuit containing multiple independent sources and linear elements (e.g. resistors, inductors, capacitors) the voltage across (or the current through) any element when all the sources are acting simultaneously may be obtained by adding algebraically all the individual voltages (or the currents) caused by each independent source acting alone, with all other sources deactivated.
An independent voltage source is deactivated (made zero) by shorting it and an independent current source is deactivated (made zero) by open circuiting it. However, if a dependent source is present it must remain active during the superposition process.

Apparatus Needed

- Trainer Board (Bread board)
- DC Voltmeter
- DC Ammeter
- Three Rheostats
- One multimeter
- Connecting wires

Procedure

1. Set up the circuit as in the figure below



2. Keep both sources active by keeping S1 & S2 in the proper position (position 1).
3. Apply 5 volts from E_1 and 7 volts from E_2.
4. Set the rheostats R1, R2 & R3 above 20Ω. [Alternatively use fixed resistors above 20 Ω]

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5. Measure the current I and record it in the given table.
6. Render E2 inactive (keeping E1 active) & measure the current I' in the branch R2.
7. Render E1 inactive (keeping E2 active) & Measure the current I'' in the branch R2.
8. Verify if I= I' + I'' which would validate the superposition theorem for this particular circuit.
9. Repeat steps 4 to 7 by changing R1, R2, R3 and take a few more sets of readings.

Table

No. of Obs.	R_1 (ohms)	R_2 (ohms)	R_3 (ohms)	I_2 with both E_1 and E_2 active (amps)	I_2' with only E_1 active (amps)	I_2'' with only E_2 active (amps)
1.						
2.						
3.						

Result

1. Show the results in tabular form
2. Comment on the obtained results and discrepancies

Part B: Verification of Thevenin's Theorem

Objective

To verify Thevenin's theorem with reference to a given circuit theoretically as well as experimentally.

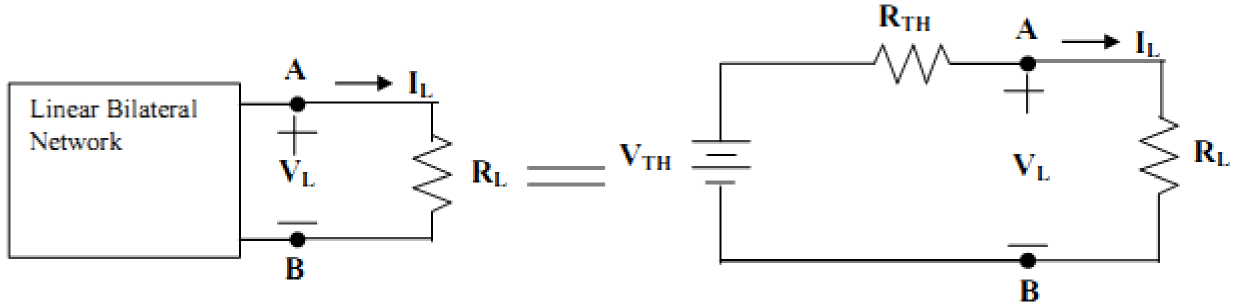
Theory

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 amount 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

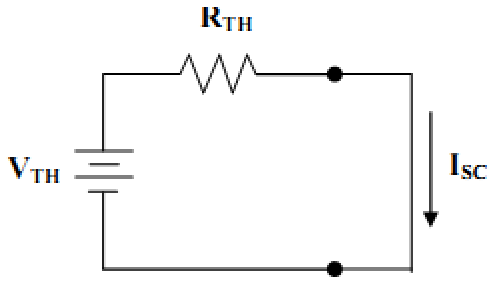
V_{th} = The open circuit voltage (V_{OC}) at the two terminals A & B.

R_{th} = The resistance looking into the terminals A and B of the network with all sources removed.



There are several methods for determining Thevenin resistance RTH. An attractive method for determining R_{TH} is: (1) determine the open circuit voltage, and (2) determine the short circuit current I_{SC} as shown in the figure; then

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



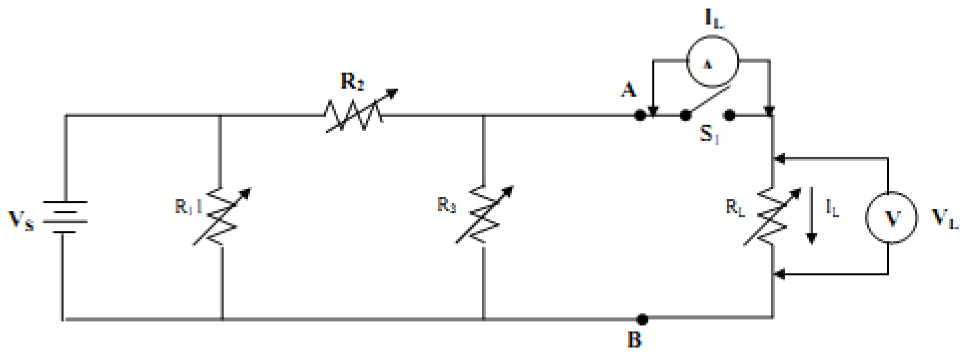
Apparatus Needed

- Trainer Board (Bread board)
- DC Voltmeter
- DC Ammeter
- Four Rheostats
- One multimeter
- Connecting wires

Procedure

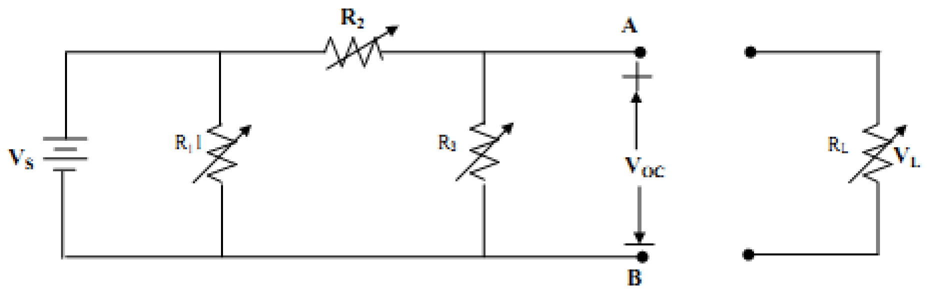
For original circuit

1. Arrange the original circuit as shown in the figure below. Apply 5 V dc from power supply. Use suitable fixed resistors for R1, R2 and R3.
2. Measure V_L, I_L for three values of R_L & record the data in the table



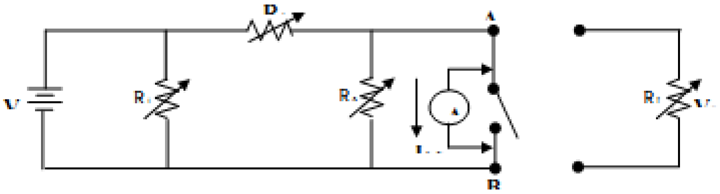
Finding V_{TH} and R_{TH}

3. Remove the load resistance and find the open circuit voltage between terminals A & B. This voltage is Thevenin Voltage i.e. $V_{TH} = V_{oc}$



4. Place a short circuit between terminals A & B and find the short circuit current I_{SC}. Divide the open circuit voltage by the short circuit current to find the Thevenin Resistance R_{TH} i.e.

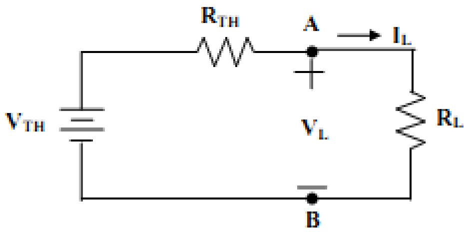
$$R_{TH} = \frac{V_{OC}}{I_{SC}}$$



Alternatively find the Thevenin resistance by opening R_L , disabling the voltage source and measuring the resistance across terminal AB using multimeter and verify that in both cases the resistance is same.

For Thevenin Equivalent Circuit

5. Construct the Thevenin's equivalent circuit as shown in figure below 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 values of R_L determined in step 2. Compare these values with previous values.



Tables

Table1: Data for Original circuit R_1= , R_2= , R_3= , V_S=

No. of Obs.	Values of R_L	Load Voltage V_L	Load current I_L
1.			
2.			
3.			

V_{TH} = , R_{TH} =

Table2: Data for Thevenin equivalent circuit

No. of Obs	Values of R_L	Load Voltage V_L	Load current I_L
1.			
2.			
3.			

Result

1. Find theoretically the Thevenin equivalent circuit for the values of R_0, R_2, R_3 & V_S recorded in table. Also find I_L,V_L.
2. Show the results in tabular form
3. Comment on the obtained results and discrepancies

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