Lab 1

Experiments On Resistive Circuits

Aim: Verify Thevenin's and Norton's equivalent representations.

1. Breadboard & Resistors

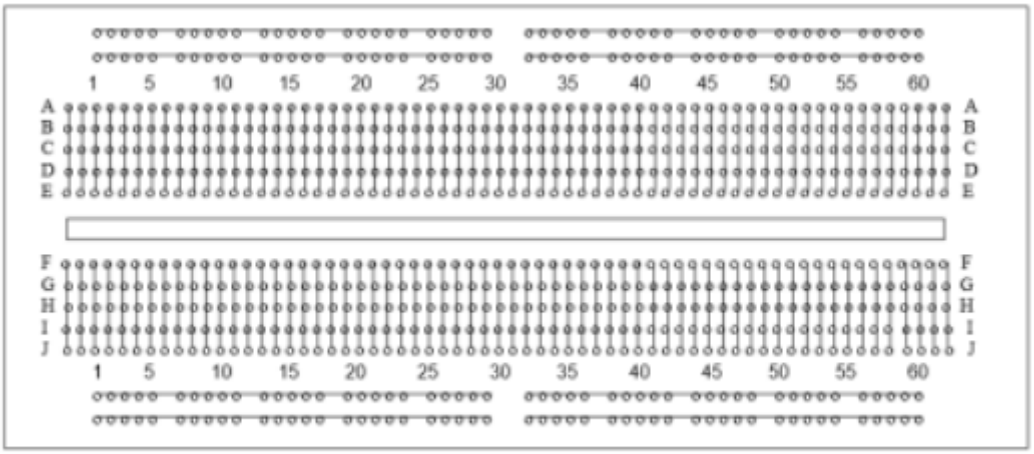
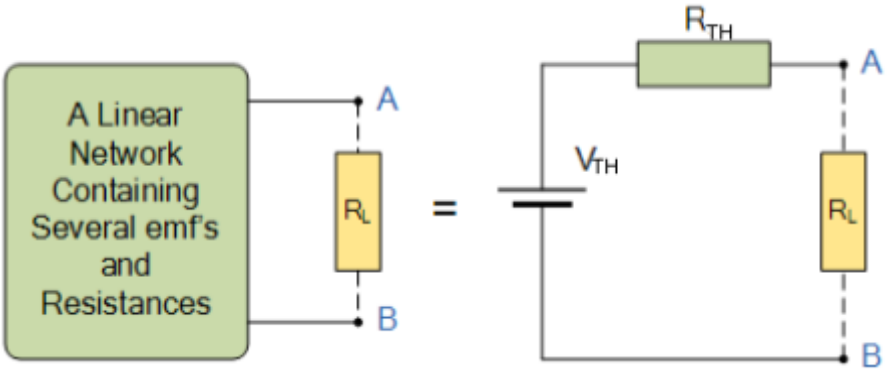


Fig. 1.1 Breadboard Schematic

Resistors: Go through this **link**

2. Thevenin's Theorem: *Thevenin's theorem states that "Any linear circuit containing several voltages and resistances can be replaced by just one single voltage in series with a single resistance connected across the load".*



Theoretical Calculations:

a) Refer to the circuit as shown in Fig. 1

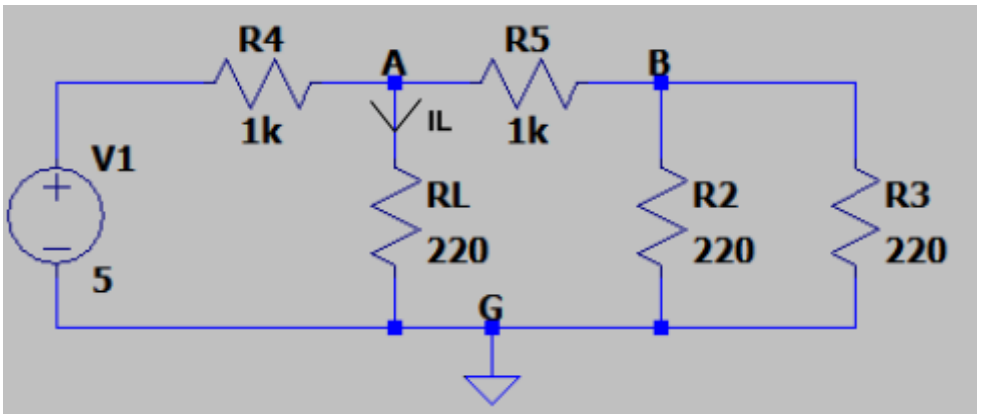
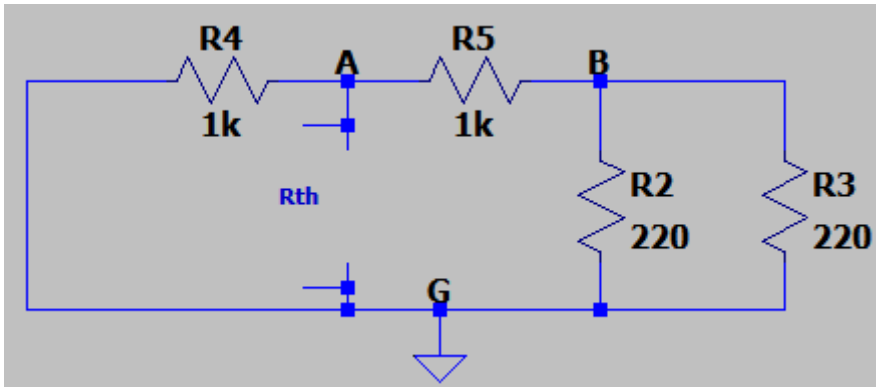


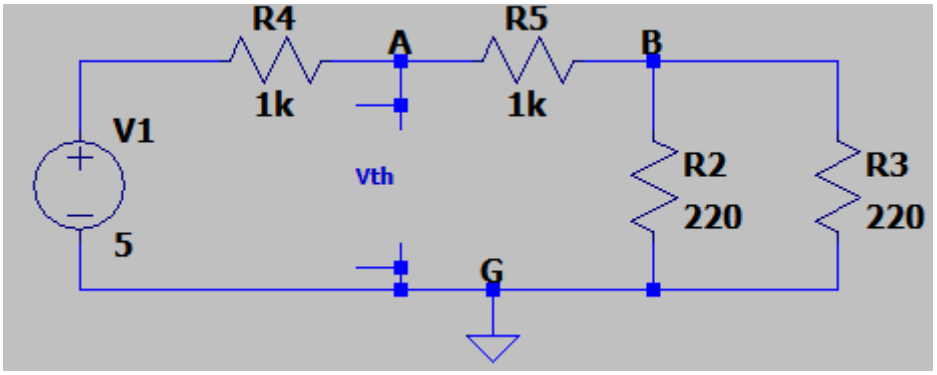
Fig. 1

b) You need to find Thevenin's resistance (R_{TH}), Thevenin's voltage (V_{TH}), Load Voltage (V_L) and Load Current (I_L).

c) For calculating Thevenin's resistance (R_{TH}), remove load R_L, short all voltage sources, open all current sources & calculate equivalent resistance (R_{TH}) between nodes A & G as shown below.



d) To calculate the Thevenin's voltage (V_{TH}), remove load R_L, reconnect the voltage sources back into the circuit and calculate the voltage between nodes A & G as shown below.



e) Once you have both (R_{TH}) and (V_{TH}) values, connect the circuit as shown in Fig. 2

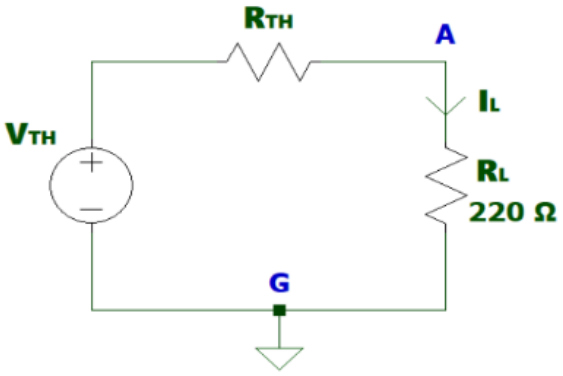
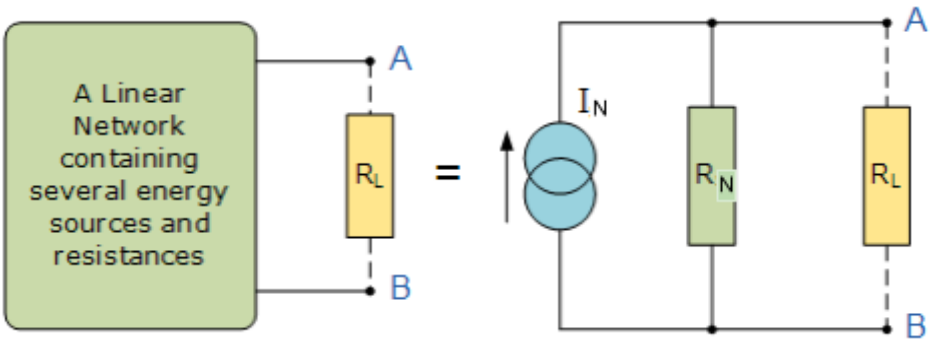


Fig. 2

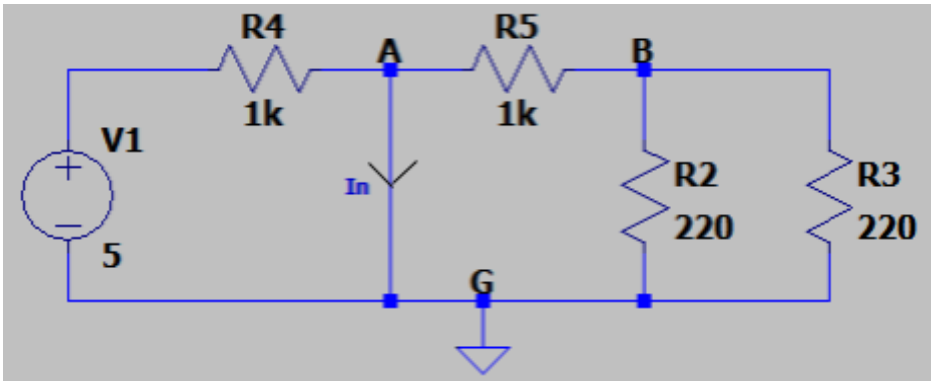
f) Now calculate the voltage (V_L) & current (I_L) across the load (R_L).

3. **Norton's Theorem:** ***Thevenin's theorem states that "Any linear circuit containing several energy sources and resistances can be replaced by a single Constant Current generator in parallel with a Single Resistor".***



Theoretical Calculations:

a) Refer to the circuit as shown in Fig. 1
b) You need to find Short Circuit/Norton's current (I_N), Equivalent resistance (R_N)(which is same as R_{TH}), Load Voltage (V_L) and Load Current (I_L).
c) Equivalent resistance (R_N) calculation will remain same as Thevenin's resistance.
d) To calculate the Norton's current (I_N), remove load R_L and short circuit the terminals A & G with a wire. Reconnect the voltage sources back into the circuit and now calculate the current between nodes A & G as shown below.



e) Once you have both (R_N or R_{TH}) and (I_N) values, connect the circuit as shown in Fig. 3.

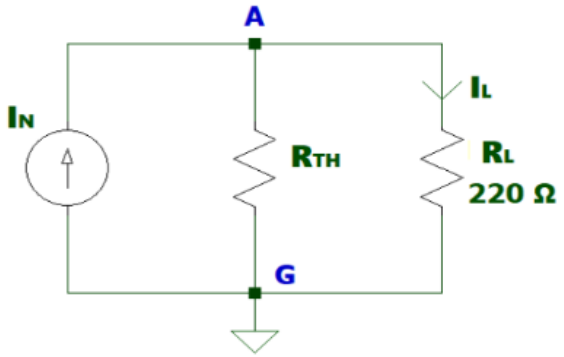


Fig.3

f) Now calculate the voltage (V_L) & current (I_L) across the load (R_L).

4. Experimental procedure using LTSpice :

a) Connect the circuit in the LTSpice schematic window as shown in Fig. 1
b) Assign values to the components (i.e. resistors, voltage source)
c) Measure the current I_L by keeping the cursor on top of the resistor R_L (the ammeter icon will show up, then click on it). Measure the voltage V_L across R_L by placing the cursor on node A and dragging it to node G. This will give you the load voltage and current directly.

(For Thevenin's Theorem)

d) Now remove the R_L(220 Ω) resistor between A and G (ground) and measure the voltage at node A. This gives Thevenin's Voltage V_{TH} across AG.
e) Now you have both R_{TH} (calculated manually) and V_{TH} values, connect the circuit as shown in Fig. 2 and measure load current & voltage by keeping the cursor at node A (for voltage) and on R_L (for current).
f) Compare the values of load voltage and current in point (c) and (e).

(For Norton's Theorem)

g) Short node A to G (just replace the resistor R_L with a wire) and measure the current through the short circuit path (i.e R_4). This will be the short circuit current or Norton's Current (I_N) in the branch AG.
h) Now you have both R_{TH} (calculated manually) and (I_N) values, connect the circuit as shown in Fig. 3 and measure load current & voltage by keeping the cursor at node A (for voltage) and on R_L (for current).
i) Compare the values of load voltage and current in point (c) and (h).

5. Hardware Implementation:

Draw the same circuit as done on LTSpice and repeat all steps. Note down the practical values.

6. Observation Table:

Thevenin's and Norton's equivalence across the branch AG i.e. $R_L = 220\Omega$

S. No	Parameter	Theoretical results	LTspice results	Practical results
1	R_{TH} (Equivalent Resistance)			
2	V_{TH} (Thevenin's voltage)			
3	I_N (Norton's current)			
4	V_L (Load Voltage)			
5	I_L (Load Current)			

Table 1

Deliverables:

When coming to the lab:

- Check the file format & grading rubrics (already posted on the classroom (BE Lab Flow).
- Submit the LTSpice file (.asc) to the classroom (individual task).
- Keep the theoretical & LTSpice results with you on a rough copy.