Izmir Institute of Technology
Elec. & Electronics Eng.
Dep.

LAB 3

THEVENIN AND NORTON EQUIVALENT CIRCUITS

Preparation Tasks

I-) The Thevenin equivalent of any electric circuit is represented by Thevenin Resistance (R_s) and Thevenin Voltage (V_s) as shown in figure 1,where R_U is the load of the given circuit.

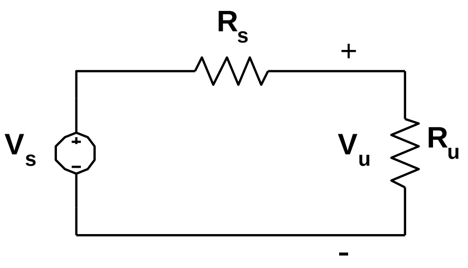


Figure 1. Thevenin Equivalent Circuit

According to the circuit given in figure 1

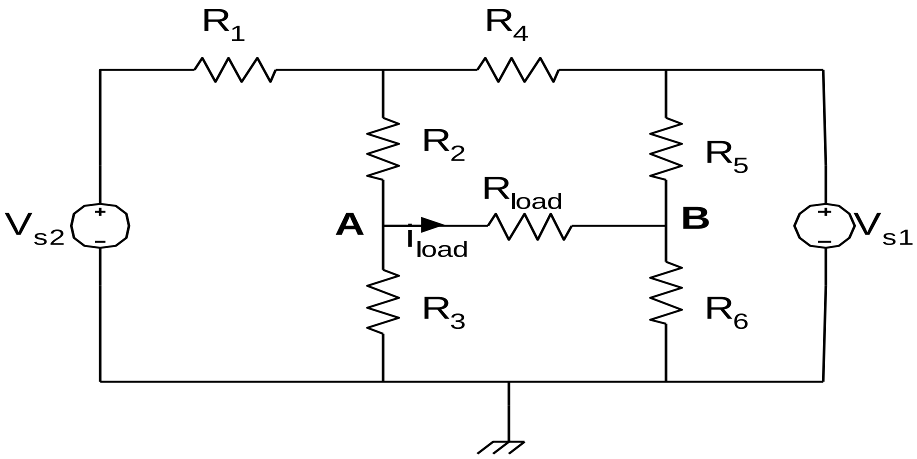
a- Find R_U such that $V_U = V_S /2$
b- Find the power, P_U , dissipated in R_U .
c- For an arbitrary value of R_U , find P_U as a function of V_s , R_s , and R_U .
d- From (c), for what value of R_U will P_U be maximum?
e- Compare the answers from (a) and (d).

II-) When you try to analyze a complex circuit as that in figure 2, if you are interested mainly in the circuit seen by the output load, you can solve for the behavior of two simpler circuits instead, one for no load (Thevenin), and one for a short circuit load (Norton).

a- Draw these circuits.
b- How many node equations will you need for each circuit?
c- Could any of the circuit elements be omitted without affecting the Thevenin or Norton equivalent resistance? If so, why?

As an alternate to the above, you can use the superposition theorem and calculate the separate open circuit contributions of the two voltage sources to the Thevenin voltage. In this case, is the Thevenin resistance different for the two cases? Explain?

Lab Work



R_1=1.2kΩ, R_2=10kΩ, R_3=5.6kΩ,

R_4=10kΩ, R_5=2.7kΩ, R_6=4.7kΩ,

R_{load}=1.8kΩ

V_{s1} = 10 V, V_{s2} = 6 V

Figure 2. A *Linear Circuit to Study Thevenin and Norton theorems*

1-Find the Thevenin equivalent circuit seen by the load resistor R_{Load} (i.e. calculate V_T and R_T).

2- Find the Norton equivalent circuit (I_N and R_N) seen by R_{Load}.

3- Draw the Thevenin and Norton equivalent circuits using the values calculated in (1) and (2).

4- Calculate V_L and I_L

Instructional objective

The objective of this experiment is to study Thevenin's and Norton's theorems and their application in circuit analysis.

Procedure

1. Set up the circuit in figure 2.
2. Measure the current (I_{load}) through R_{Load} and the voltage (V_L), across R_{Load} .

I_{LOAD}	V_L

3. Find the Thevenin equivalent circuit seen by R_{Load} (i.e. the equivalent circuit between nodes A & B, with R_{Load} removed from the circuit).

   To get the equivalent circuit, follow these steps:

   a- Remove R_{Load} from the circuit.

   b- Measure V_{AB} (open circuit voltage = Thevenin Voltage = V_T).

V_{AB}	

   c- Set all the voltage sources to zero volts, and use the ohmmeter to measure the equivalent resistance between nodes A and B (This is the Thevenin Resistance = R_T).

R_T	

4. Find the Norton equivalent circuit seen by R_{Load} . For this part, *DO NOT* physically apply a short to measure $I_{SC} = I_N$. Follow the instructions below.

   a- Set the potentiometer to the original load value and connect it between nodes A and B.

   b- Vary the potentiometer, and measure the voltage (V_P) across it, and the current (I_P) through it. Obtain five data points (preferably having uniform voltage spacing between them) and plot V_P vs. I_P

I_{LOAD}	V_L