DEPT. OF ELECTRICAL & ELECTRONICS ENGINEERING

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY, Kattankulathur – 603 203

Title of the experiment	**Verification of all the theorems (theivenin, norton, maximum power transfer)**
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Registration number	**RA2111050010001**
Date of experiment	**7 october 2021**

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre Lab questions		
2	Preparation of observation		
3	Execution of experiment		
4	Calculation / Evaluation of Result		
5	Post Lab questions		
Total		**15**	

Staff Signature

PRE LAB QUESTIONS

1. Define active and passive elements.

Active components control the charge flow in electronic circuits. By definition generate for any device. It is the core component to operate any device.

Passive components are quite the opposite of active, they don't require any external voltage to perform their job but they are not capable of providing energy on their own. They require external assistance from active components.

2. State Thevenin's theorem?

It states that "any two terminal linear network having a number of voltage current sources and resistances can be replaced by a simple equivalent circuit consisting of a single voltage source in series with a resistance.

3. State Norton's theorem?

It states that any two terminal current sources and resistance can be replaced by an equivalent circuit consisting of a single constant current source with parallel to single resistance.

4. Difference between dependent and independent sources?

Independent sources are those, whose value of either the voltage or current to be delivered is independent of any other parameter of the network. where as the dependent sources are those, whose value value of either the voltage or the current to be delivered is independent of any other parameter of the network.

5. What are the different types of dependent or controlled sources?

The different types of dependent sources are:-

- voltage controlled voltage source
- current controller voltage source
- voltage controlled current source

Experiment No. 2 a) Date :	THEVENIN'S THEOREM

Aim:

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

Apparatus Required:

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

Statement:

Any linear bilateral, active two terminal network can be replaced by an equivalent voltage source (V_{TH}). Thevenin's voltage or V_{OC} in series with looking pack resistance R_{TH}.

Precautions:

1. Voltage control knob of RPS should be kept at a 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 a multimeter (V_{TH}).

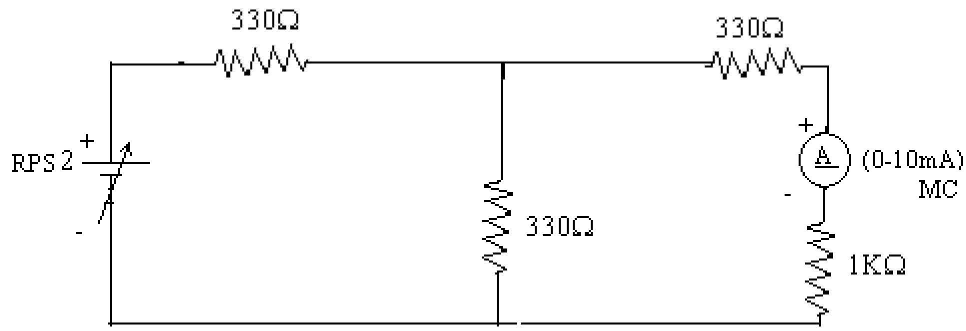
To find R_{TH}

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

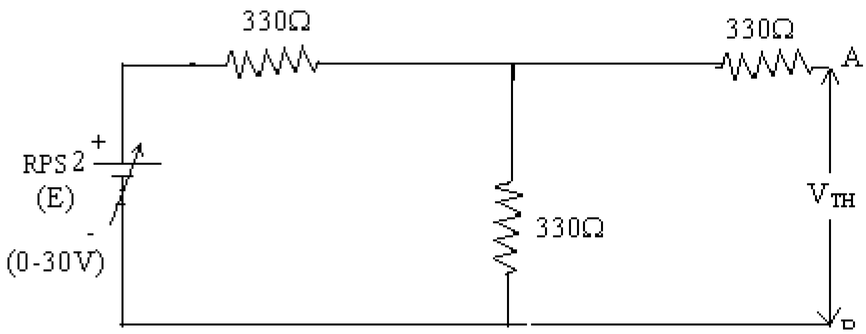
Theoretical and Practical Values

	E(V)	V_{TH}(V)	R_{TH}(Ω)	I_L (mA)	
				Circuit - I	Equivalent Circuit
Theoretical	10	4.983	495	3.34	3.34
Practical	10	5	495	3.34	3.34

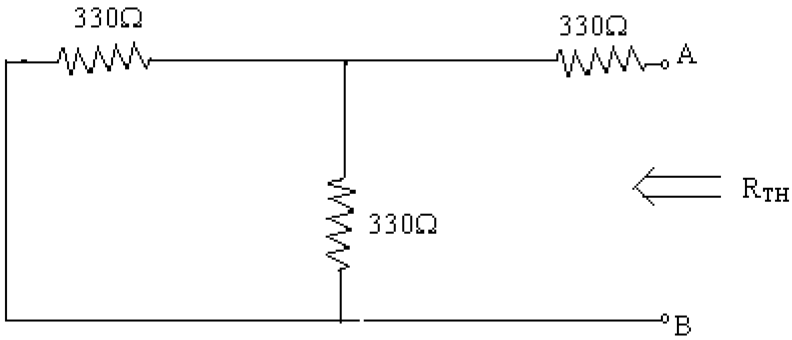
Circuit - 1 : To find load current



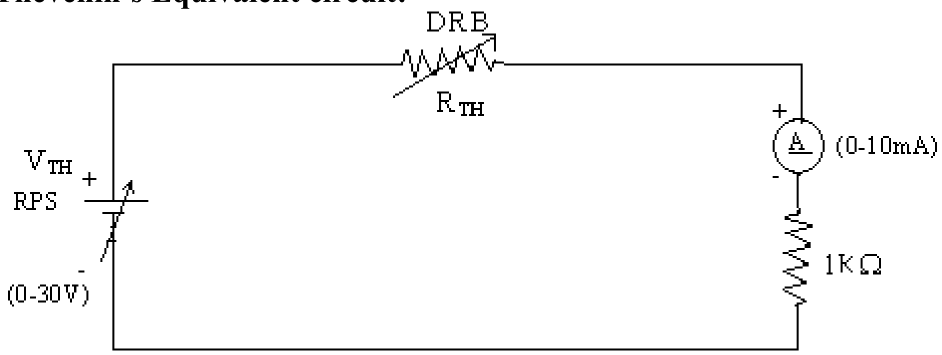
To find V_{TH}



To find R_{TH}



Thevenin's Equivalent circuit:



Model Calculations:

For V_{TH} :

R Eq= 330Ω+330Ω=330Ω

E= 10V

I= 10/660 A

=15mA

V th= 330*15

=4.95*10-3 ≈5mV

For R_{TH} :

1/Rp = 1/330 + 1/330 Rp

= 330/2

Rth = 330 + 330/2

= (660 + 330)/2

= 495 Ω

Load Current:

Eqn1 : 330I1 + 330(I1 + I2) – 10 =0

660I1 + 330I2 = 10

Eqn2 : 330I2 + 330(I1 + I2) + 1000I2 =0

330I1 + 1660I2 = 0

Eqn3 : 330I1-330I2-1000I2-10=0

330I1-1330I2=10

Eqn 1 - 2(Eqn3) gives,

660I1+330I2-10-660I1-26660I2-20=0

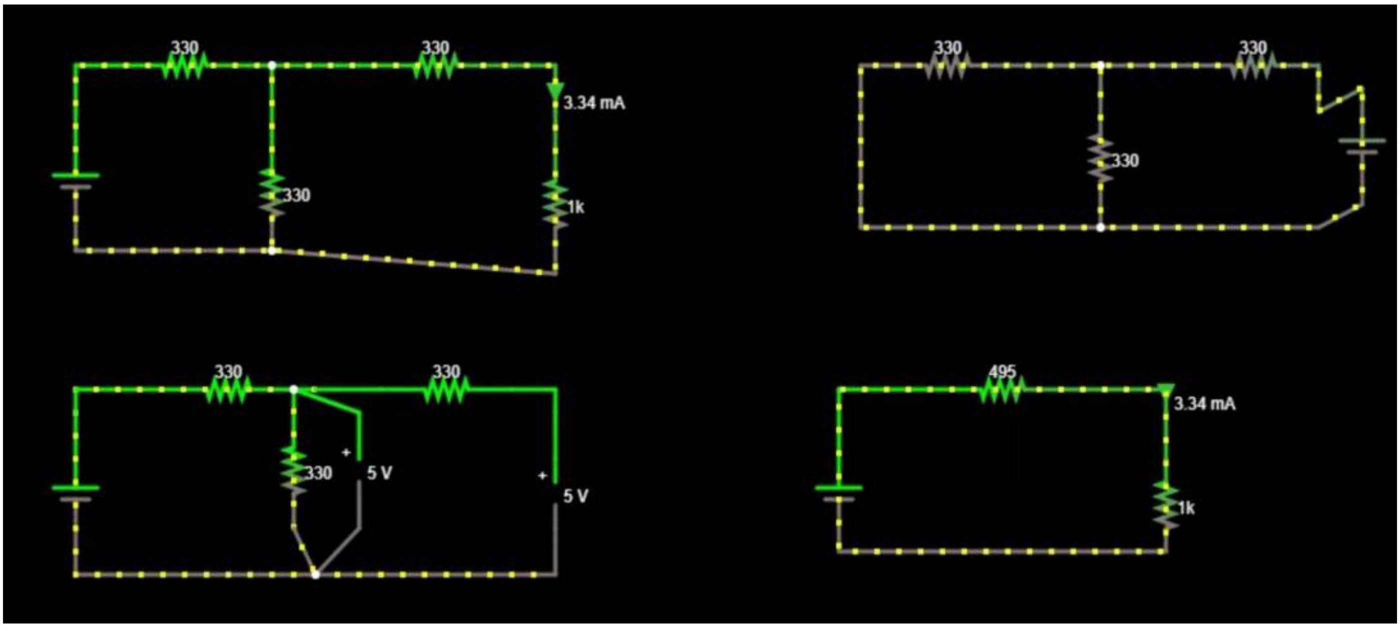
which on further solving becomes,

2990I2=-10

I2= -10/2992

= -3.34mA

Simulation output:



Result:

Hence the theivens theorem has been verified with the use of simulated and theoretical values

Experiment No. 2 b) Date :	VERIFICATION OF NORTON'S THEOREM

Aim:

To verify Norton's theorem for the given circuit.

Apparatus Required:

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

Statement:

Any linear, bilateral, active two terminal network can be replaced by an equivalent current source (I_N) in parallel with Norton's resistance (R_N)

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.

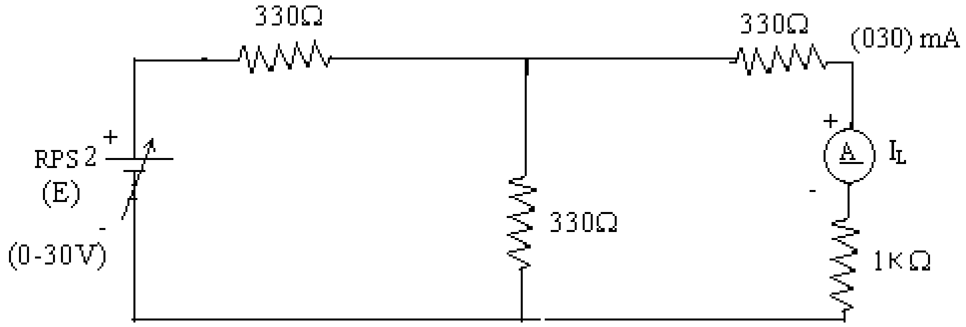
To Find R_N:

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

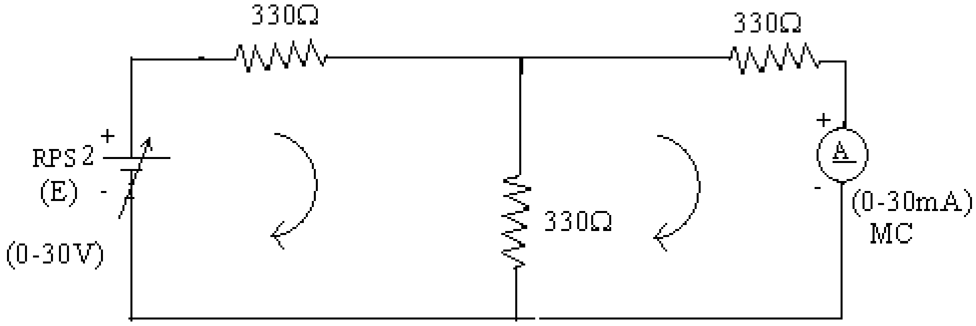
Equivalent Circuit:

6. Set I_N and R_N and note down the ammeter readings.
7. Verify Norton's theorem.

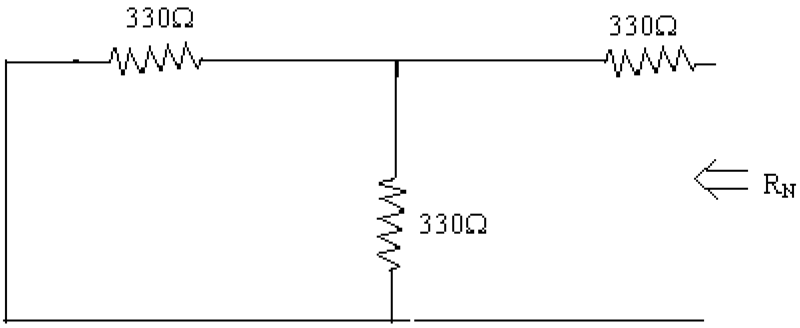
To find load current in circuit 1:



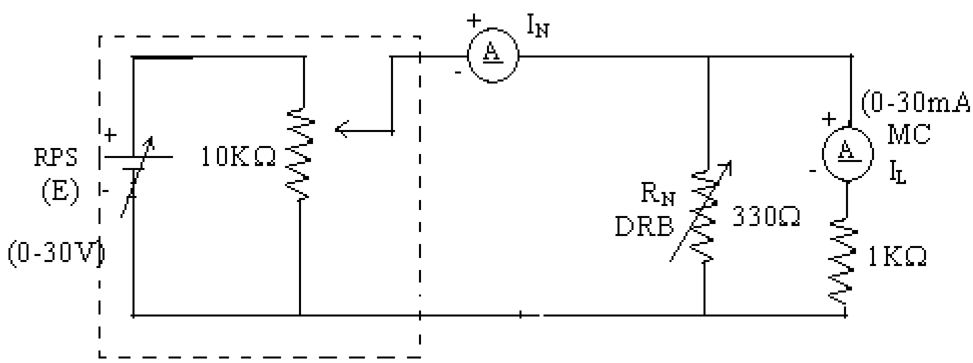
To find I_N



To find R_N



Norton's equivalent circuit



Constant current source

Theoretical and Practical Values

	E (volts)	I_N (mA)	R_N (Ω)	I_L (mA)	
				Circuit - I	Equivalent Circuit
Theoretical Values	10	10.1	495	3.34	3.34
Practical Values	10	10.1	495	3.34	3.34

Model Calculations:

For I_n:

Eqn 1: 330I1 + 330(I1-I2)-10=0

660I1 - 330I2-10=0

Eqn2: 330I2 + 330(I2-I1)=0

660I2 - 330I1=0

Eqn3: 330I1 + 330I2 - 10=0

using 1 and 3 we get,

990=20

I1=20/990

=20.2 mA

from 2 we get,

I2=I1/2

=20.2/2

=10.1mA

For R_n:

1/RP =1/330 + 1/330

= 2/330

RP=330/2

RN=330*1.5

=495Ω

LOAD CURRENT I_L:

Eqn1 : 330I1 + 330(I1-I2)-10=0

660I1- 330I2-10=0

Eqn2 : 330I2 + 330(I2-I1) + 1000I2=0

1660I2 - 330I1 = 0

Eqn3 : 330I1 + 1330I2 - 10 =0

Eqn 3*2 - Eqn1:

660I1 + 2660 I2 + 10 -660I1 + 330 I2 - 20 = 0

2990I2 = 10

I2 = 10/2990

= 3.34mA

I L USING NORTON’S CIRCUIT :

R eq = 495Ω + 1000Ω

= 1495Ω

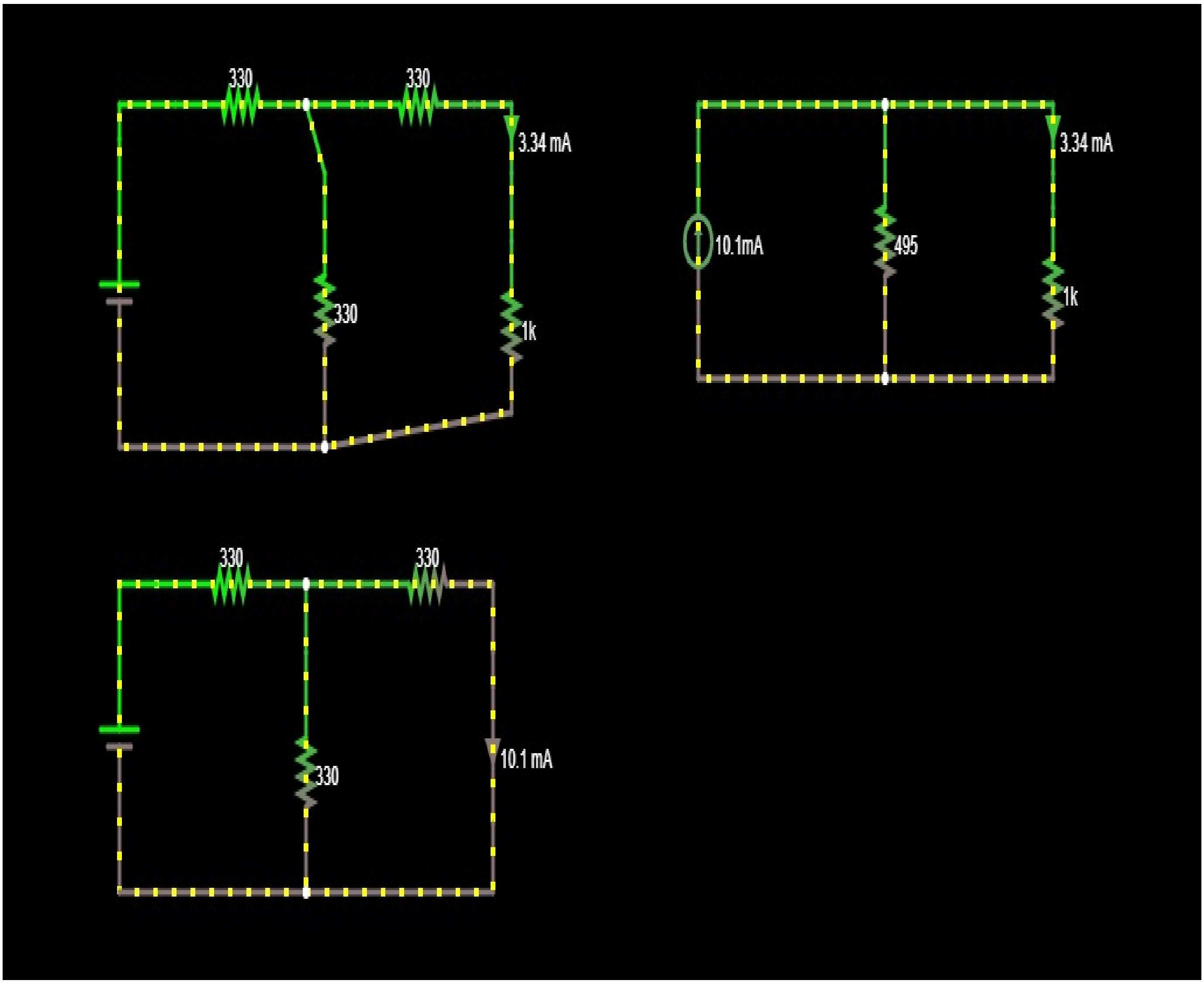
V = 10.1*4.95

= 5

I L = 5/1495

= 3.34 mA

Simulation output:



Result:

Hence, Norton's Theorem has been verified with the help of simulator and theoretical calculations.

Experiment No. 2 c) Date :	VERIFICATION OF MAXIMUM POWER TRANSFER THEOREM

Aim:

To verify maximum power transfer theorem for the given circuit

Apparatus Required:

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

Statement:

In a linear, bilateral circuit the maximum power will be transferred from source to the load when load resistance is equal to source resistance.

Precautions:

1. Voltage control knob of RPS should be kept at a 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})

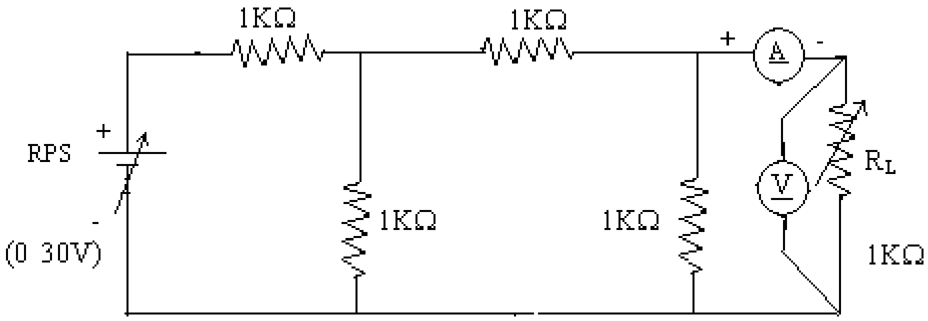
To find R_{TH}:

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

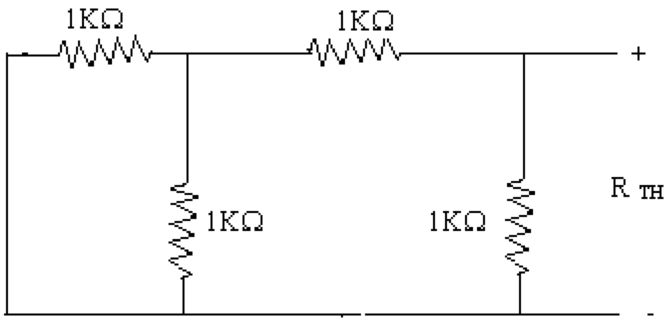
Equivalent Circuit:

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.

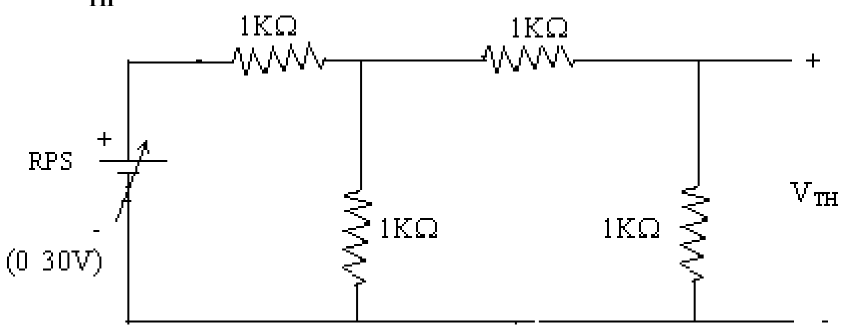
Circuit - 1



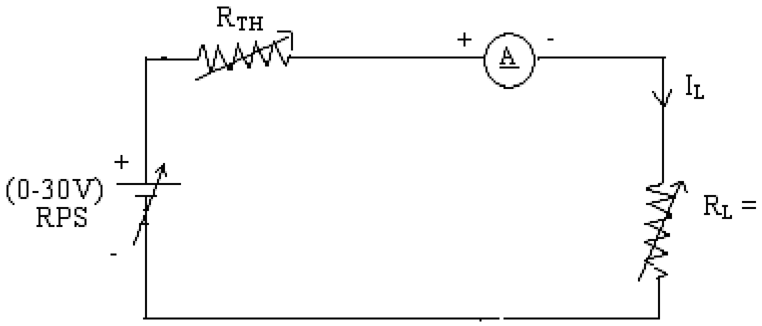
To find V_{TH}



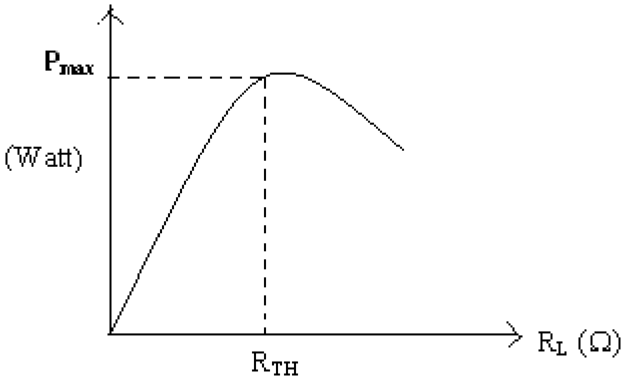
To find R_{TH}



Thevenin's Equation Circuit



Power V_S R_L



Circuit – I

Sl.No.	RL (Ω)	I (mA)	V(V)	P=VI (watts)
	100	2.86	0.28571	0.816
	200	2.5	0.5	1.25
	400	2	0.8	1.6
	600	1.67	1	1.67
	800	1.43	1.14	1.63
	1000	1.25	1.25	1.56
	1400	1	1.4	1.4
	1800	0.833	1.5	1.25

To find Thevenin's equivalent circuit

	V_{TH} (V)	R_{TH} (Ω)	I_L (mA)	P (milli watts)
Theoretical Value	2	600	1.67	1.67
Practical Value	2	600	1.67	1.67

Model Calculations:

For Vth

$R_{eq1} = 1+1$

$= 2\Omega$

$R_{eq2} = 5/3\Omega$

V= IR

10= I * 5/3 I =

6 mA

This the current flowing through the 1000Ω = ⅓ *6 **=2mA**

V=IR

V=2*1

= 2V

thus,

Vth = 2V

For R_{Th}:

R series = ½Ω + 1kΩ

=3/2 or 1.5kΩ R

parallel-

$1/R_{eq}$ = ⅔ + 1

= 5/3 kΩ

thus,

$R_{eq} =$ 3000/5

= 600Ω

$R_{th} =$ 600Ω

Maximum power transfer when Zth = ZL

thus, load resistance = 600Ω

V=IR

2=I*(600+600)Ω I

= 2/1200

= 1.67 mA

Voltage drop across load resistance:

V=IR

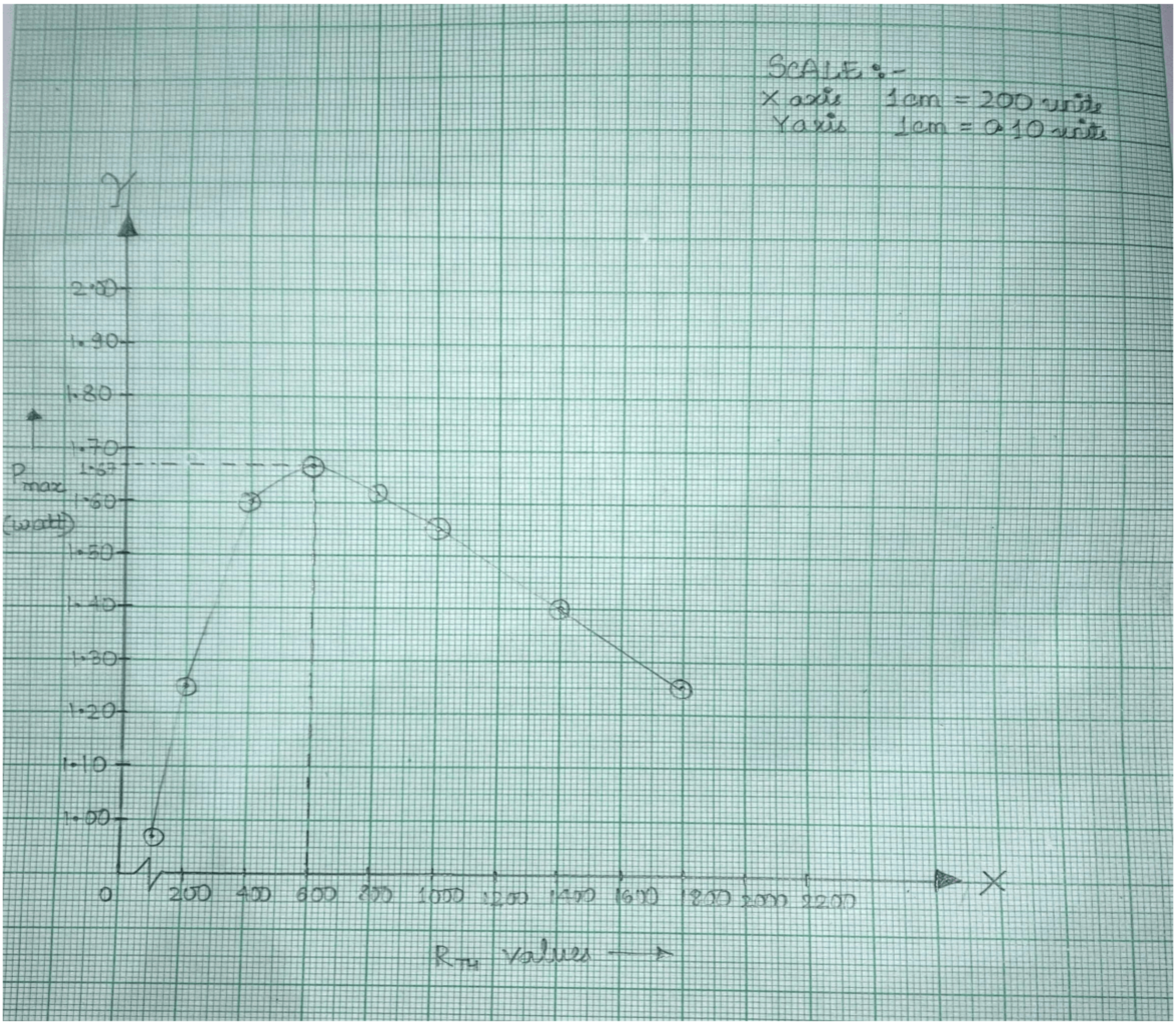
V=1.67*600

V=1v

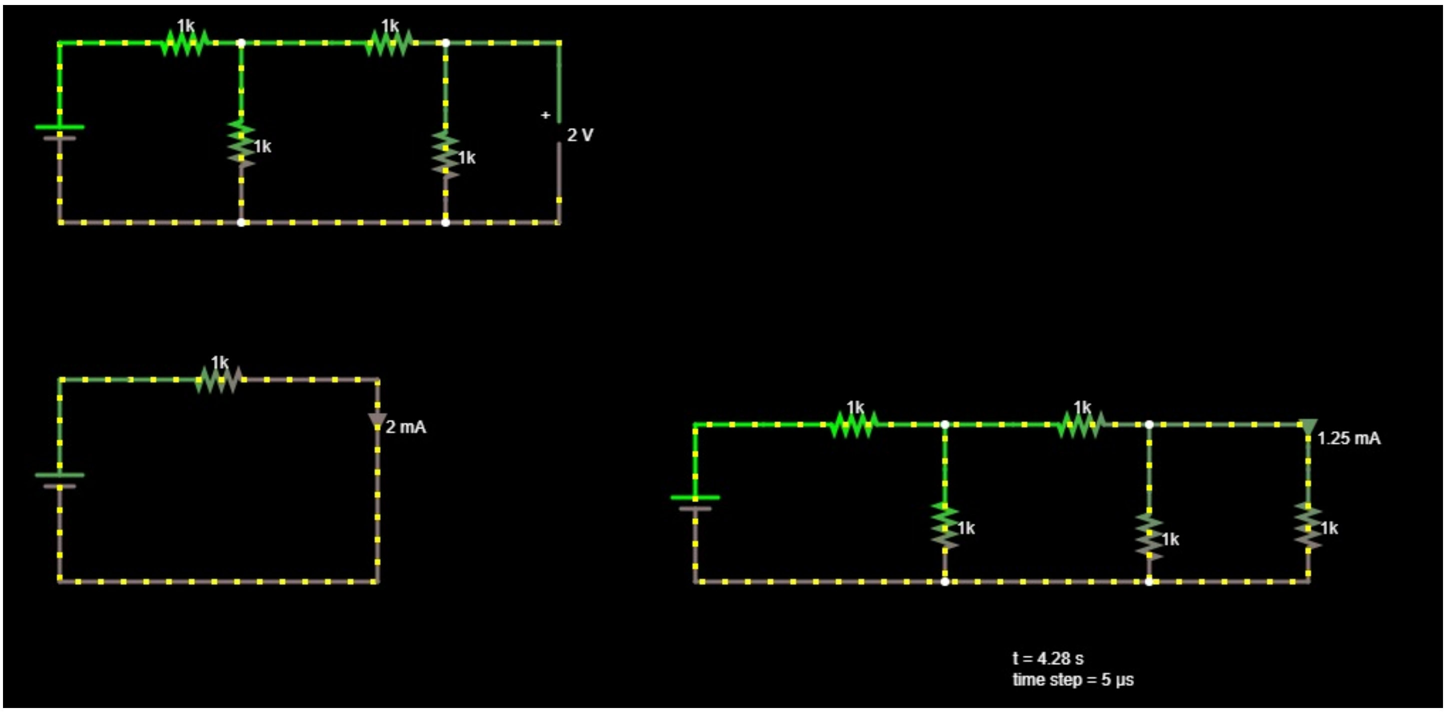
Power dissipated in the circuit=VI

= 1*1.67

= 1.67 mW



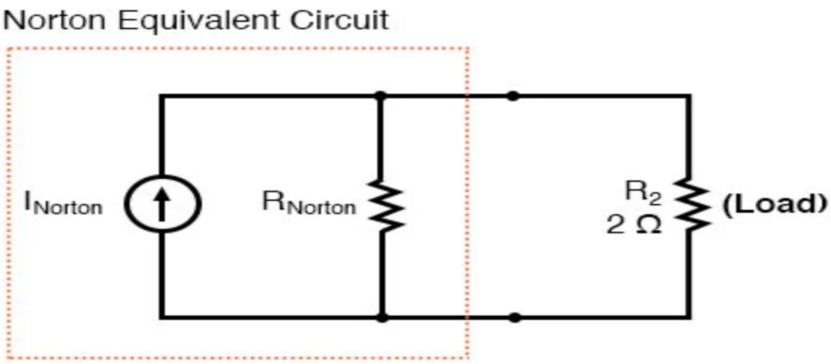
Simulation output:



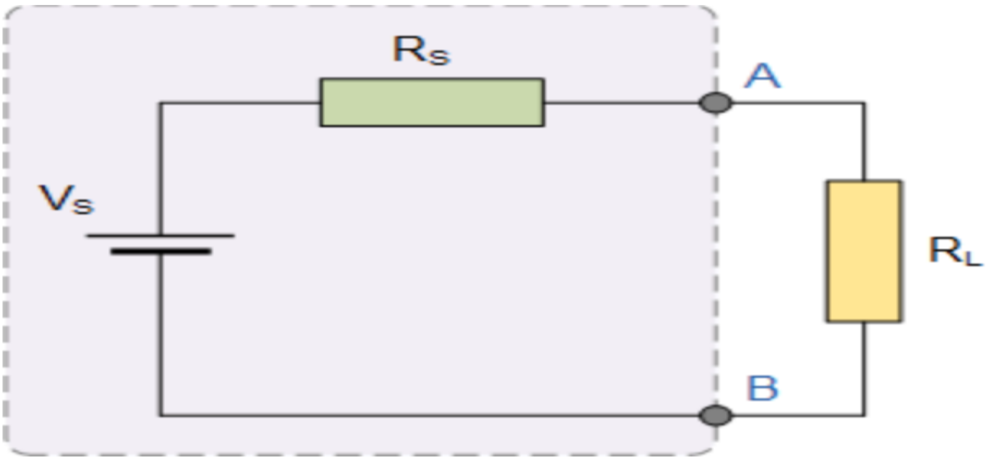
Result:
Hence, Maximum Power Theorem has been verified with the help of simulator and theoretical calculations.

POST LAB QUESTIONS

1. **Draw the Norton's equivalent circuit.**



2. **Draw the Thevenin's equivalent circuit**



3. **State maximum power transfer theorem.**
   Answer - Maximum power transfer theorem states that the DC voltage source will deliver maximum power to the variable load resistor only when the load resistance is equal to the source resistance.

4. **Write the conditions for maximum transfer theorem in DC as well as AC circuits.**

   Answer- The condition for maximum power transfer from source to load, the value of load impedance should be conjugate of the source impedance. This essentially means that the value of Z_L should be equal to (R – jX). This is the maximum power transfer theorem for AC circuits.

5. Write the steps to find I_N
Answer- The steps included in solving circuit for newton's current are as follows-

1. Remove the Load resistance and short circuit that wire.
2. Solve the circuit using nodal analysis or Kirchhoff's laws.
3. The resulting short circuit current would be the value of Norton's current