DEPT. OF ELECTRICAL & ELECTRONICS ENGINEERING

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY, Kattankulathur – 603 203

Title of Experiment	:	**2. VERIFICATION OF ALL THEOREMS- (THEVENIN, NORTON, MAXIMUM POWER TRANSFER)**
Name of the candidate	:	Abdul Ahad
Register Number	:	RA2111028010094
Date of Experiment	:	04/10/2021

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre Lab questions	5	
2	Preparation of observation	15	
3	Execution of experiment	15	
4	Calculation / Evaluation of Result	10	
5	Post Lab questions	5	
Total		**50**	

Staff Signature

PRE LAB QUESTIONS

1. Define Lumped and distributed elements.

Lumped elements: Disturbed systems assume that electrical properties R, L, C etc which are distributed across the entire circuit. These systems are applicable for high frequency applications.

Disturbed elements: Lumped elements are those elements in which electrical properties like R, L, C etc are assumed to be located on a small space of the circuit. These systems are applicable for low frequency applications.

2. State 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".

3. State Norton's theorem?

Norton'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".

4. List the applications of Thevenin's and Norton's theorems?

Applications of thevenin's theorem:

It is used for analyzing power systems and other circuits where one particular load resistor in the circuit and re calculation of the circuit is essential with each trial value of load resistance, to find the voltage across it and current through it.

Source modeling and resistance measurement by using the wheat-stone bridge provide applications for thevenin's theorem.

Applications of norton's theorem:

It is used to reduce a complex circuit into simple circuit.

Norton's theorem is useful to solve problems on parallel generators with unequal emf's and unequal impedances.

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

There are four types:

Voltage controlled current source.

Current controlled current source.

Current controlled voltage source.

Voltage controlled voltage source.

Experiment No. 2 a) **Date :** 04/10/2021	**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 a 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 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 multimeter (V_{TH}).

To find R_{TH}

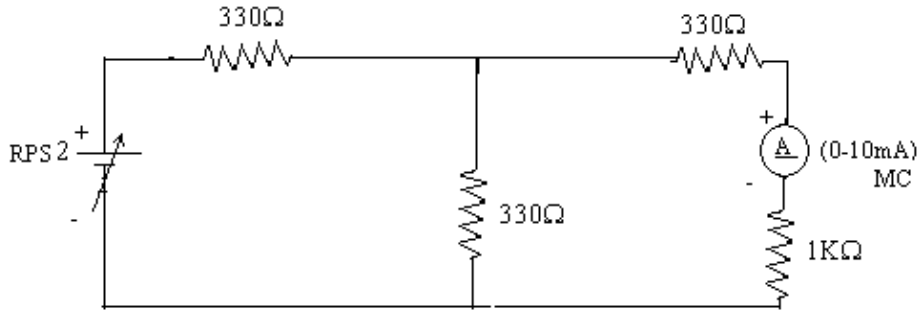
4. To find the Thevenin's resistance, remove the RPS and short circuit it and find the R_{TH} using multimeter.
5. Give the connections for equivalent circuit and set V_{TH} and R_{TH} and note the corresponding ammeter reading.
6. Verify Thevenins theorem.

Theoretical and Practical Values

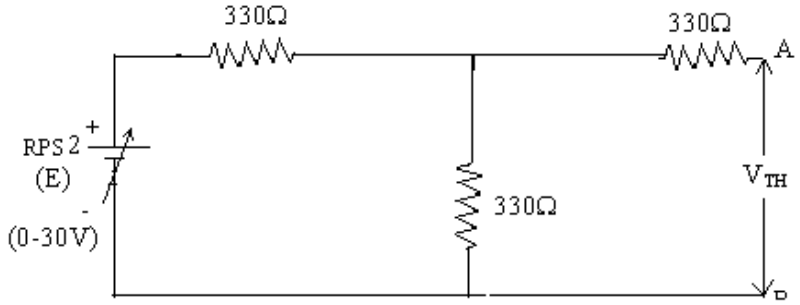
	E(V)	V_{TH}(V)	R_{TH}(Ω)	I_L (mA)	
				Circuit – I	Equivalent Circuit

Theoretical	10	5	495	3.34	3.34
Practical	10	5	495	3.34	3.34

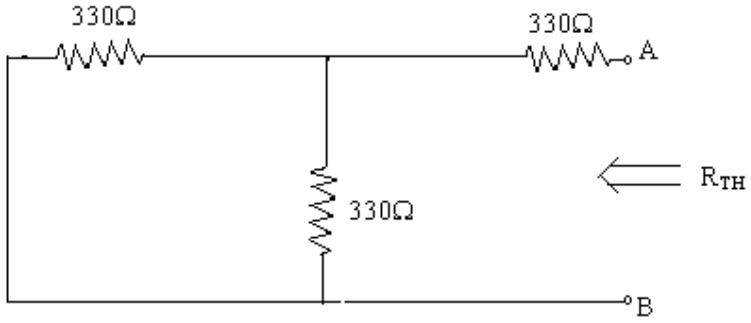
Circuit - 1 : To find load current



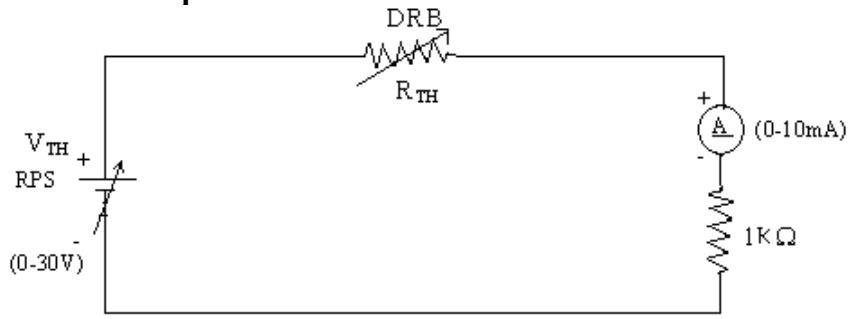
To find V_{TH}



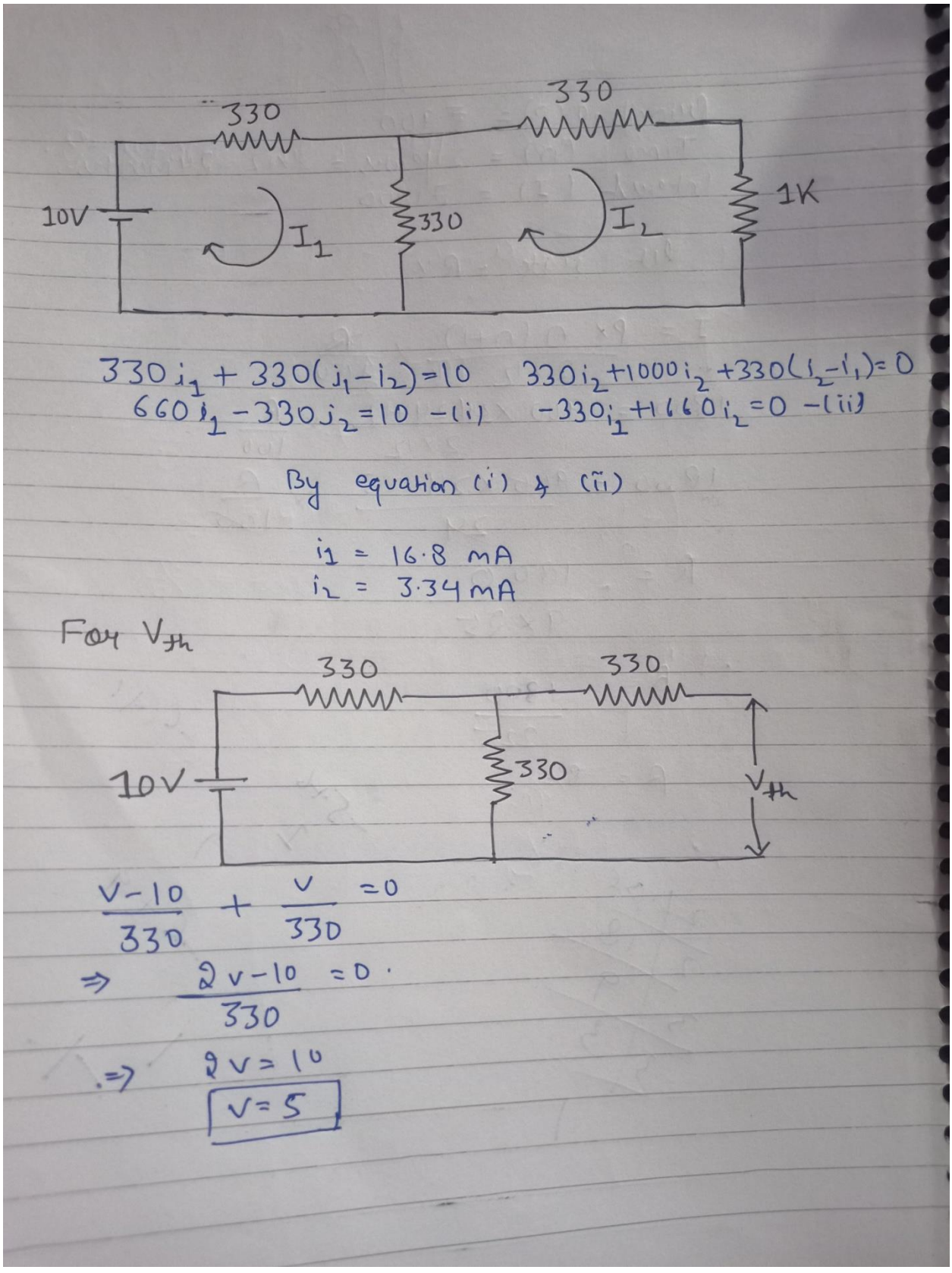
To find R_{TH}

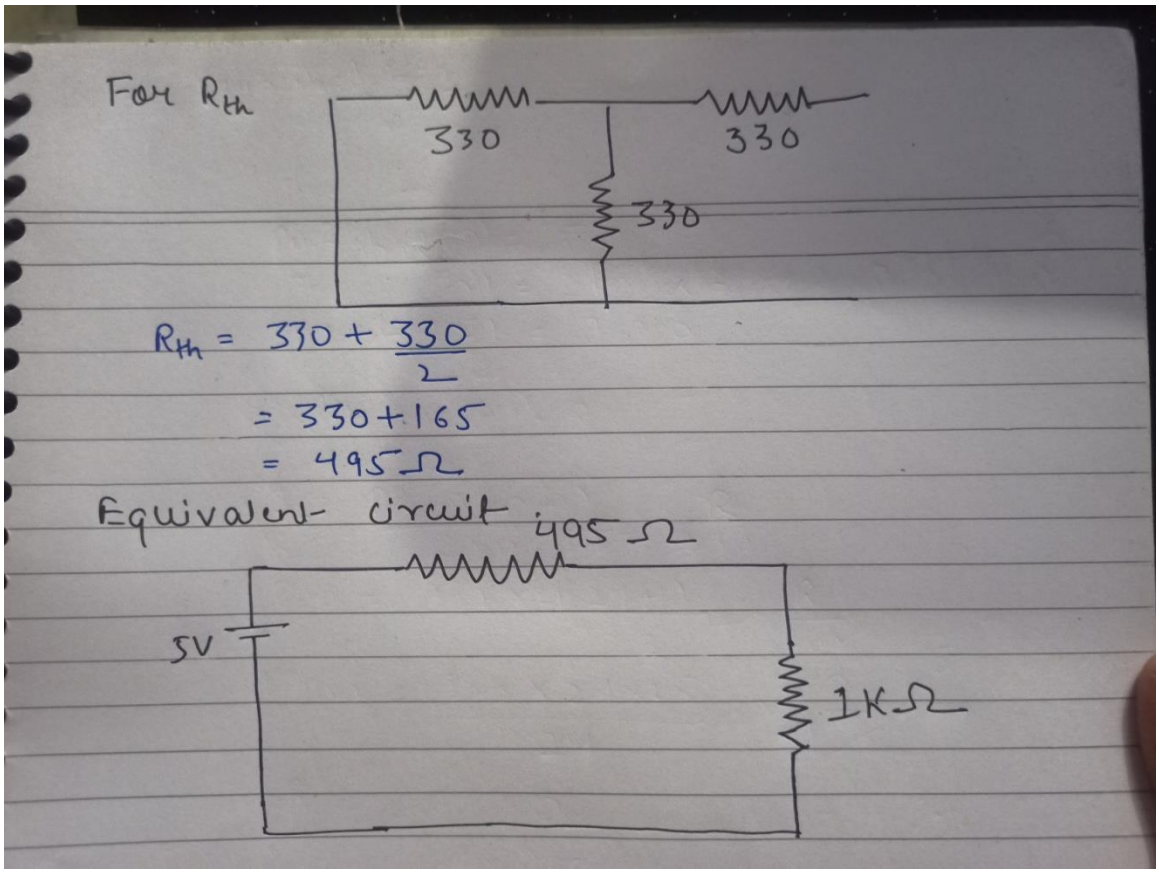


Thevenin's Equivalent circuit:

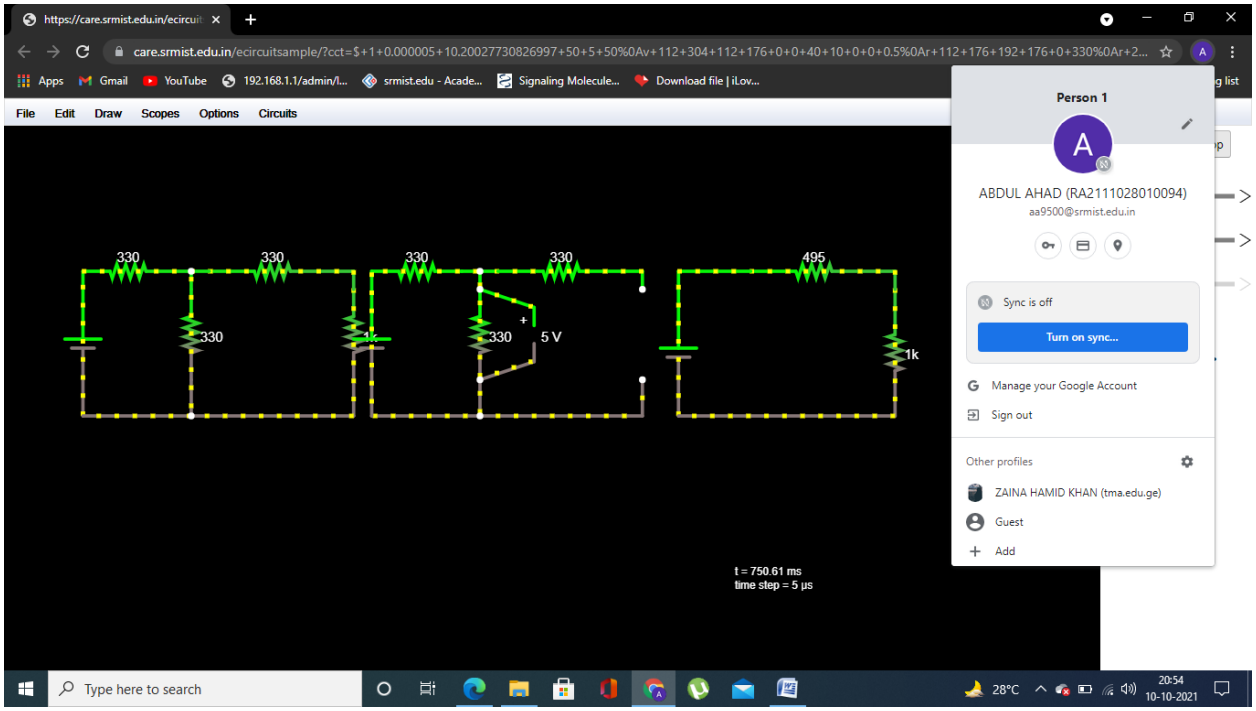


Model Calculations:




For R_{Th}
330
330
330
$R_{Th} = 330 + \frac{330}{2}$
$= 330 + 165$
$= 495\,\Omega$
Equivalent circuit
495 Ω
5V
1KΩ

Result: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care.srmist.edu.in/ecircuitsample/?cct=$+1+0.000005+10.20027730826997+50+5+50%0Av+112+304+112+176+0+0+40+10+0+0+0.5%0Ar+112+176+192+176+0+330%0Ar+2...
Apps
Gmail
YouTube
192.168.1.1/admin/l...
srmist.edu - Acade...
Signaling Molecule...
Download file | iLov...
File
Edit
Draw
Scopes
Options
Circuits
330
330
330
330
330
330
5 V
495
1k
t = 750.61 ms
time step = 5 µs
Person 1
ABDUL AHAD (RA2111028010094)
aa9500@srmist.edu.in
Sync is off
Turn on sync...
Manage your Google Account
Sign out
Other profiles
ZAINA HAMID KHAN (tma.edu.ge)
Guest
Add
Type here to search
28°C
20:54
10-10-2021

Experiment No. 2 b) Date : 04/10/2021	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.

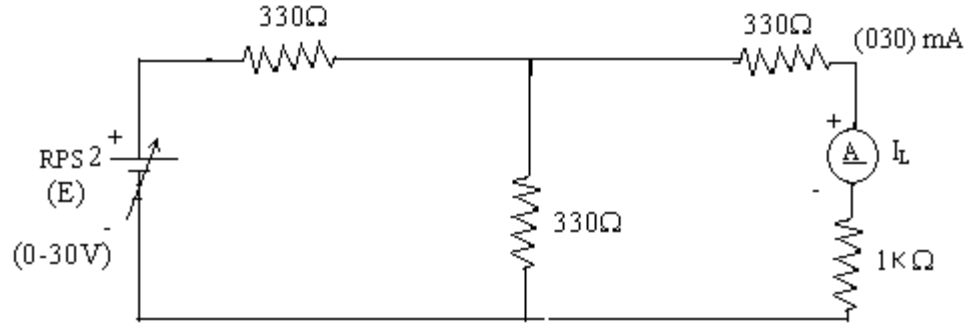
To Find R_N:

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

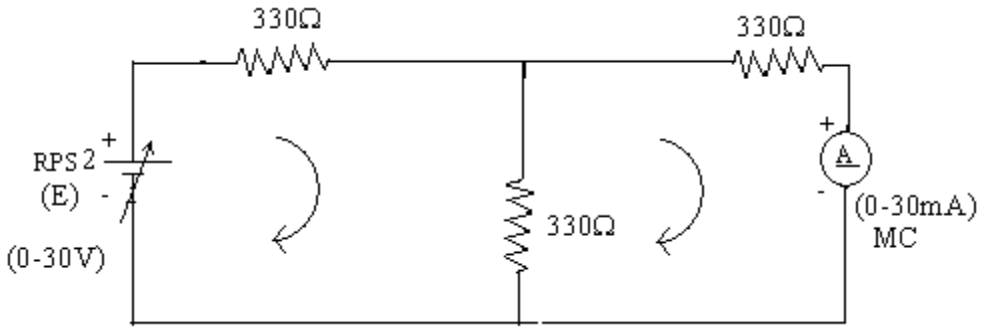
Equivalent Circuit:

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

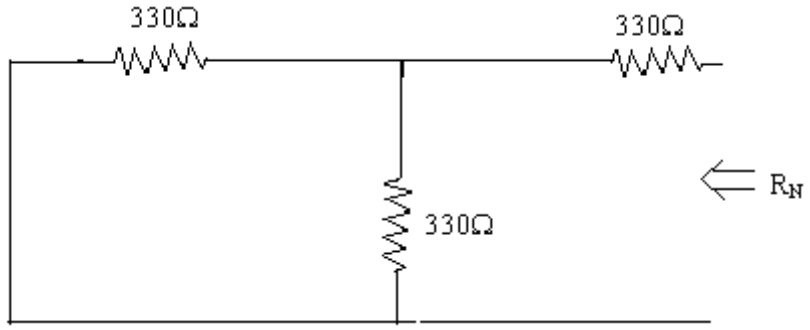
To find load current in circuit 1:



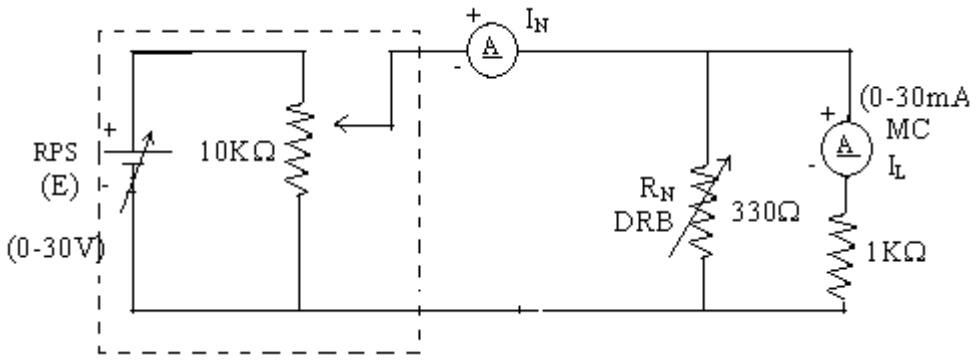
To find I_N



To find R_N



Norton's equivalent circuit

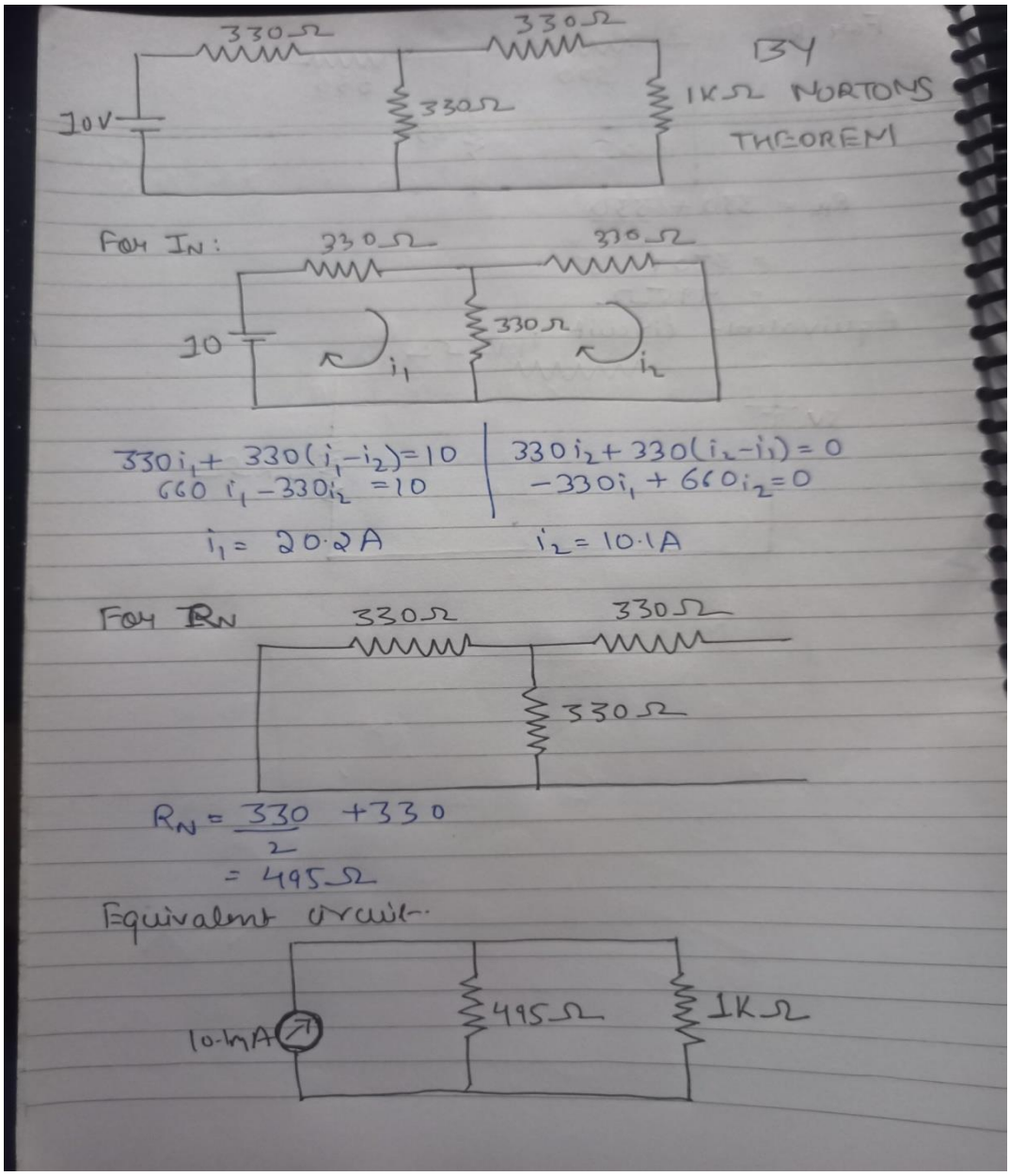


Constant current source

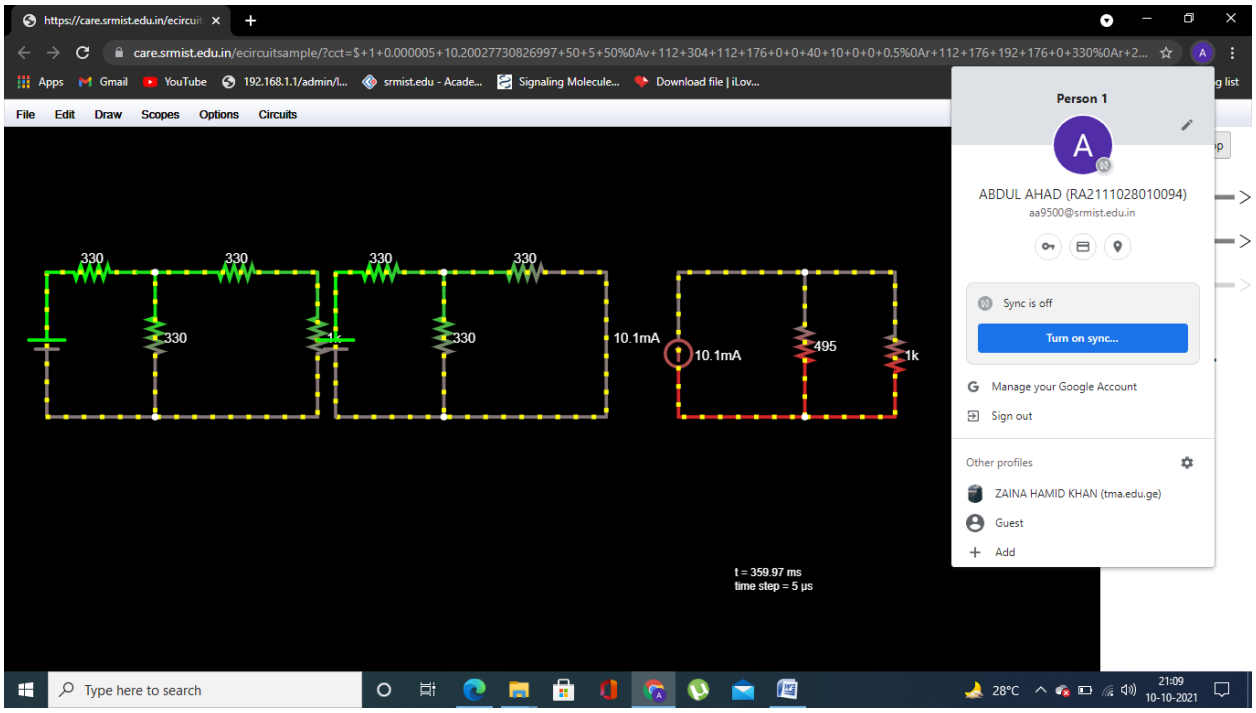
Theoretical and Practical Values

	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:



Result:


https://care.srmist.edu.in/ecircuit
care.srmist.edu.in/ecircuitsample/?cct=$+1+0.000005+10.20027730826997+50+5+50%0Av+112+304+112+176+0+0+40+10+0+0+0.5%0Ar+112+176+192+176+0+330%0Ar+2...
Apps
Gmail
YouTube
192.168.1.1/admin/l...
srmist.edu - Acade...
Signaling Molecule...
Download file | iLov...
File
Edit
Draw
Scopes
Options
Circuits
330
330
330
330
330
330
1k
10.1mA
10.1mA
495
1k
t = 359.97 ms
time step = 5 µs
Person 1
ABDUL AHAD (RA2111028010094)
aa9500@srmist.edu.in
Sync is off
Turn on sync...
Manage your Google Account
Sign out
Other profiles
ZAINA HAMID KHAN (tma.edu.ge)
Guest
Add
Type here to search
28°C
21:09
10-10-2021

Experiment No. 2 c) Date : 04/10/2021	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 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})

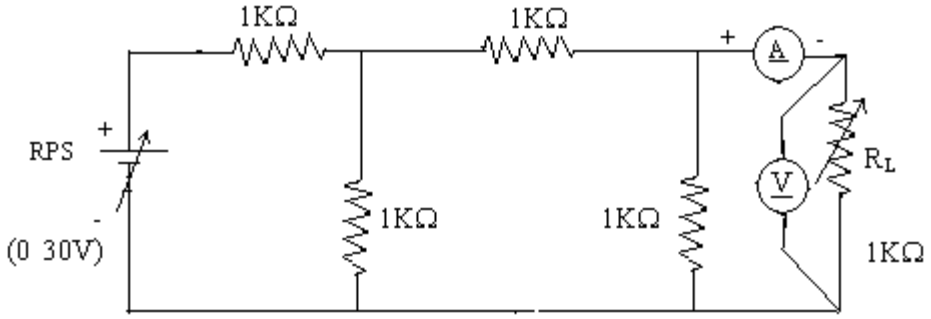
To find R_{TH}:

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

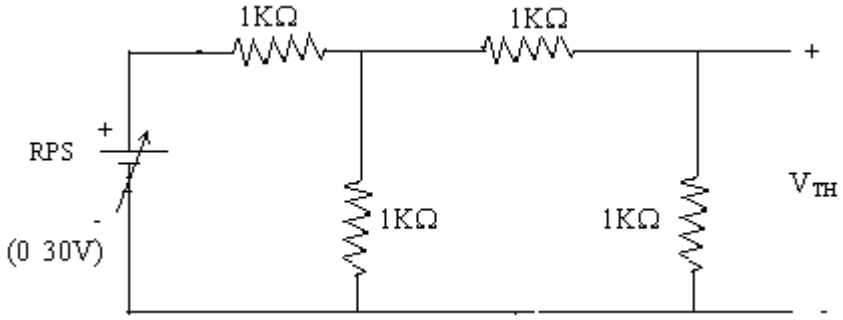
Equivalent Circuit:

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.

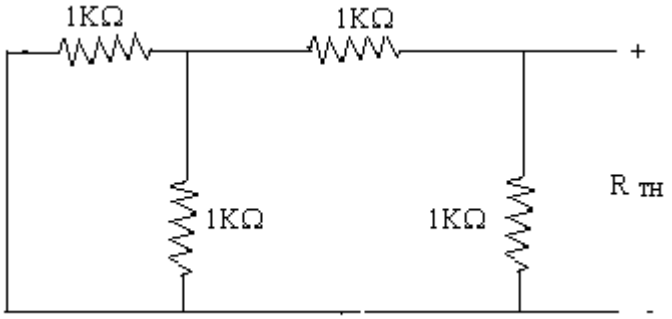
Circuit - 1



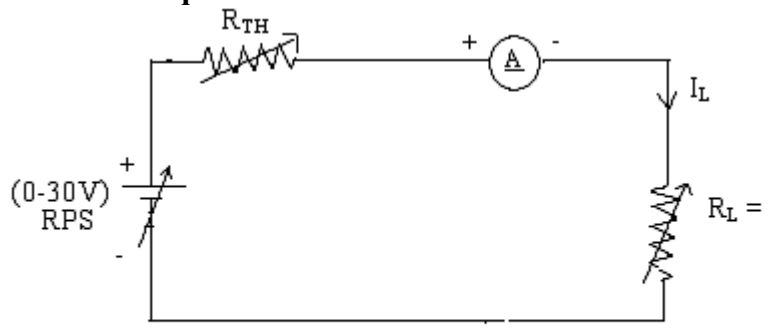
To find V_{TH}



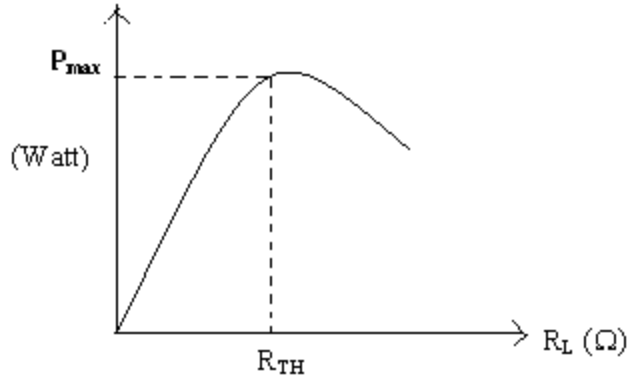
To find R_{TH}



Thevenin's Equation Circuit



Power Vs R_L



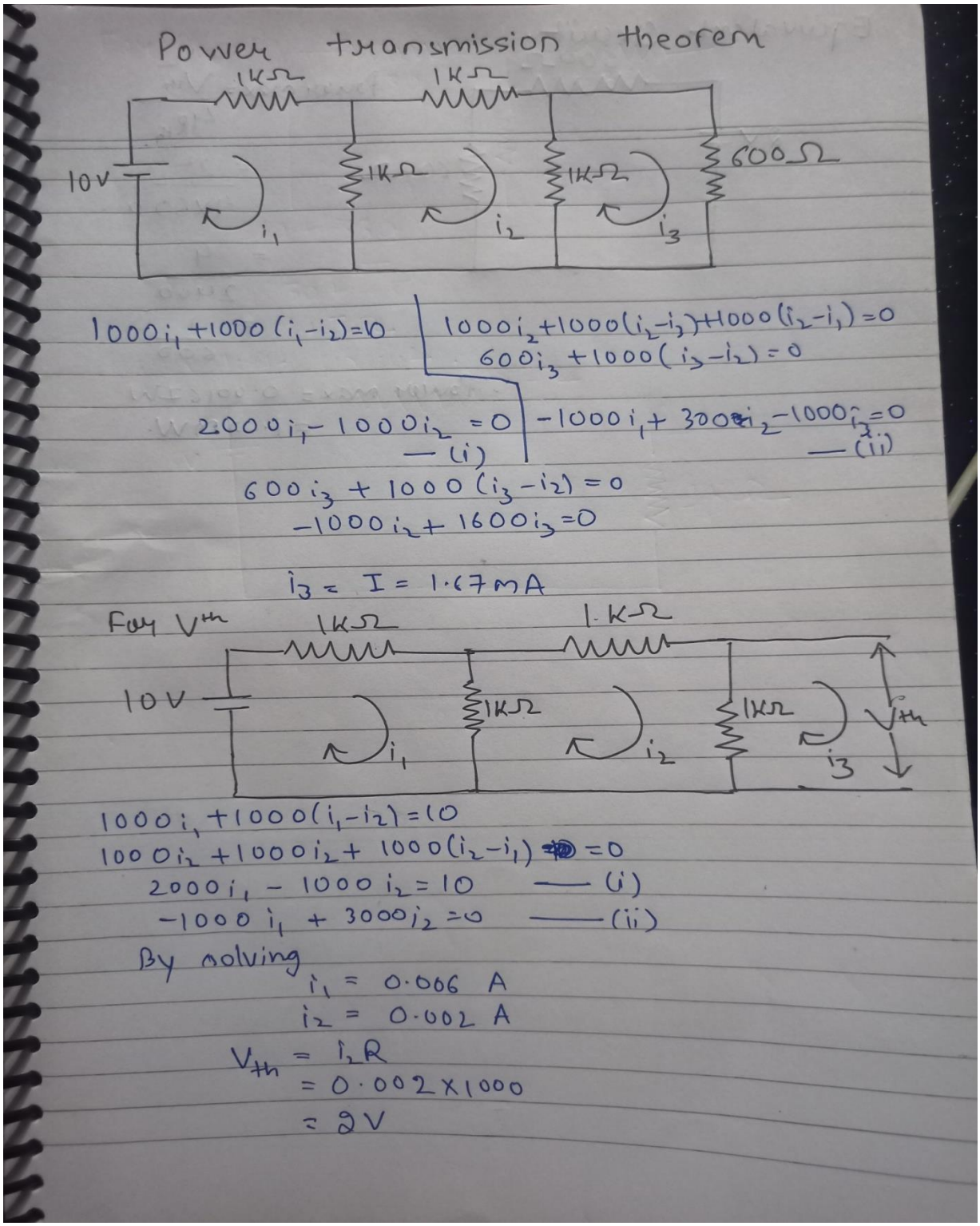
Circuit – I

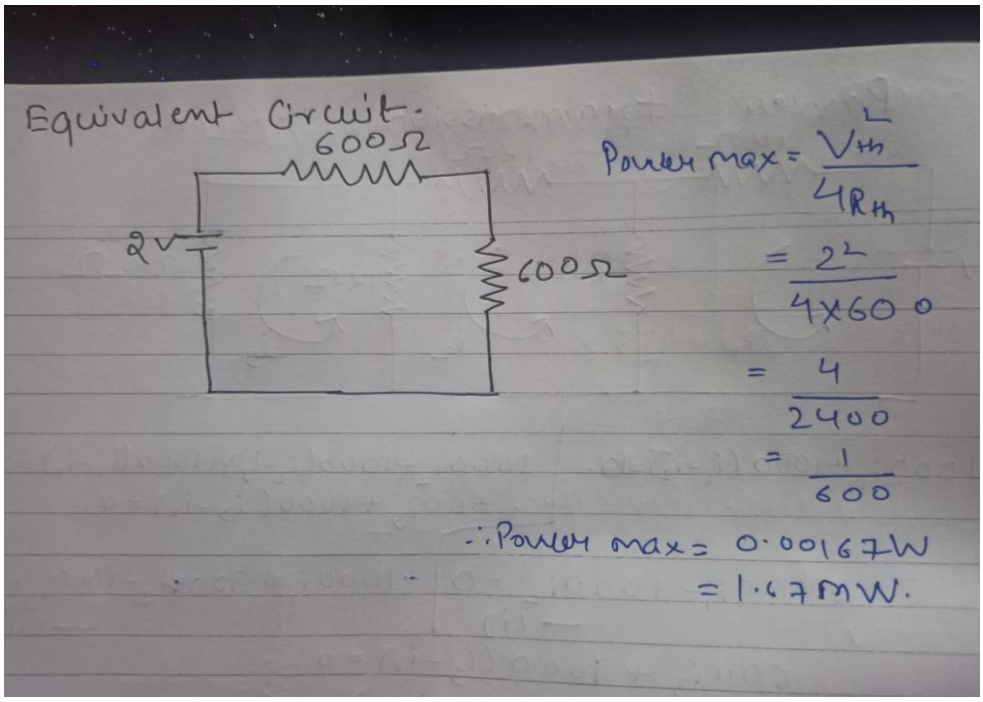
Sl.No.	RL (Ω)	I (mA)	V(V)	P=VI (watts)
1	300	2.22	666.67	1.48
2	400	2	800	1.6
3	500	1.82	909.09	1.65
4	600	1.67	1000	1.67
5	700	1.54	1080	1.66
6	800	1.43	1140	1.63
7	900	1.33	1200	1.6

To find Thevenin's equivalent circuit

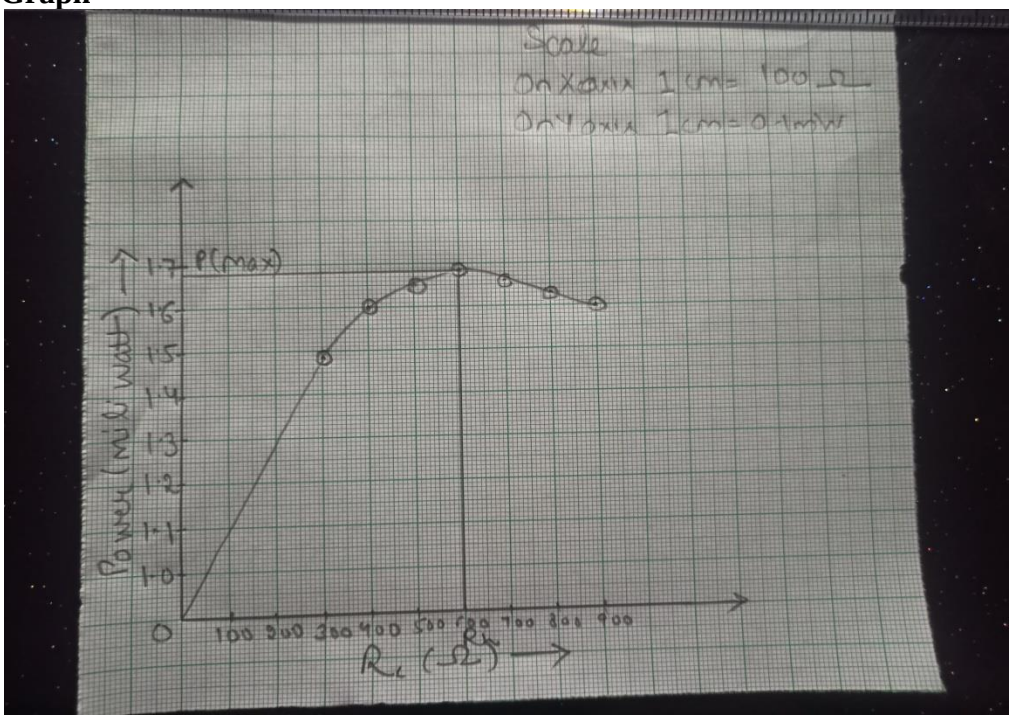
	V_{TH} (V)	R_{TH} (Ω)	I_L (mA)	P (milli watts)
Theoretical Value	2	600	1.67	1.67
Practical Value	2	600	1.67	1.67

Model Calculations:

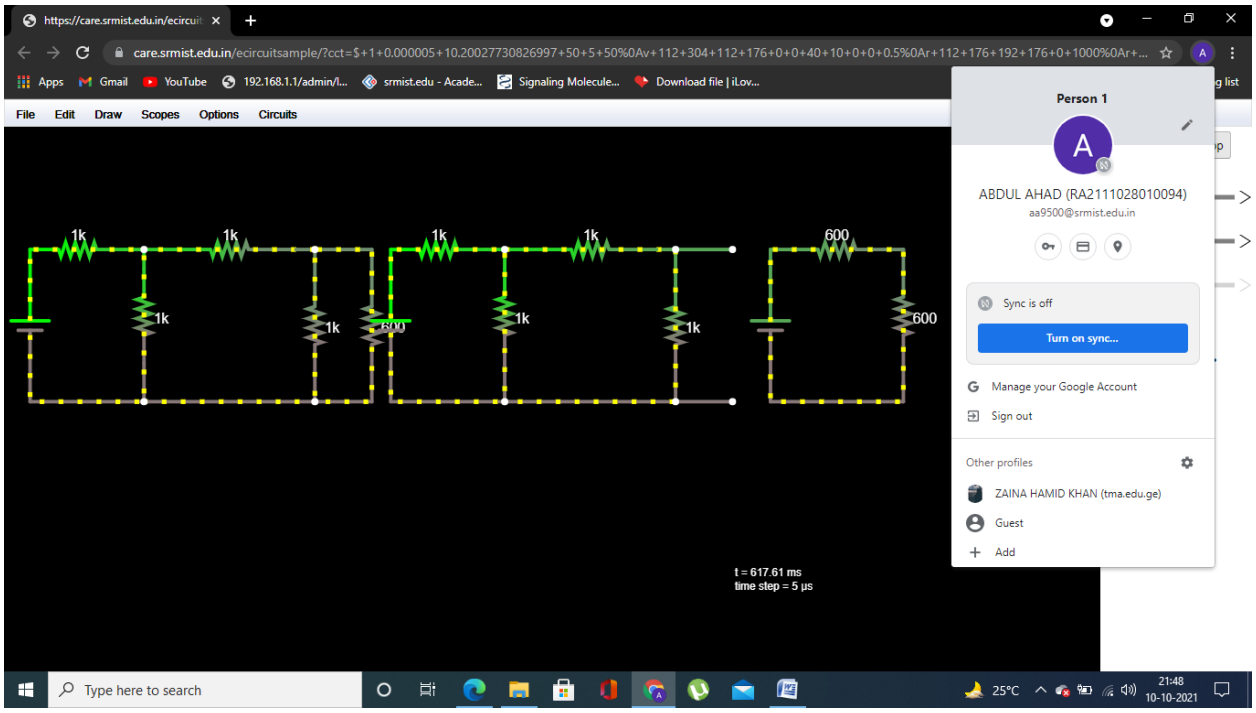



Equivalent Circuit.
600Ω
2V
600Ω
Power max = $\frac{V_{th}^2}{4R_{th}}$
$= \frac{2^2}{4 \times 600}$
$= \frac{4}{2400}$
$= \frac{1}{600}$
∴ Power max = 0.00167W
= 1.67mW.

Graph


Scale
On X axis 1 cm = 100 Ω
On Y axis 1 cm = 0.1mW
P(max)
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0
Power (mW)
100 200 300 400 500 600 700 800 900
R_L (Ω)

Result:


File Edit Draw Scopes Options Circuits
1k
1k
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600
1k
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600
600
t = 617.61 ms
time step = 5 µs
Person 1
ABDUL AHAD (RA2111028010094)
aa9500@srmist.edu.in
Sync is off
Turn on sync...
Manage your Google Account
Sign out
Other profiles
ZAINA HAMID KHAN (tma.edu.ge)
Guest
Add
Type here to search
25°C
21:48
10-10-2021

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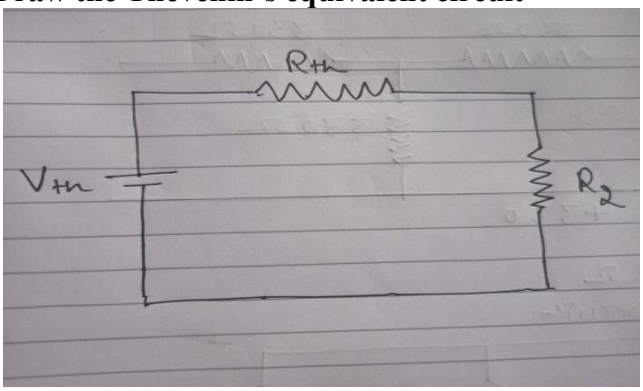
POST LAB QUESTIONS

1. **State Thevenin's Theorem.**
   Thevenin's theorem state 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".

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



3. **State maximum power transfer theorem.**
   Maximum power transfer theorem states that, to obtain maximum external power from a source with a finite internal resistance, the resistance of the load must be equal to the resistance of the source as viewed from its output terminals.

4. **Write some applications of maximum transfer theorem.**
   Radio communication.
   Ensuring successful system design.

5. **Write the steps to find I_N**
   To solve In, remove the load resistor and apply mesh analysis or nodal analysis according to the circuit.

6. **What are the steps to solve Maximum power transfer Theorem?**
   First step is to find the thevenin's resistance and thevenin's voltage and draw an equivalent circuit with v thevenin, r thevinen and load resistor. Then use the formulae:
   Power = (v thevenin)^2 / 4*r thevenin