JADAVPUR UNIVERSITY

Faculty of Engineering & Technology

.....Electrical..... Engg. Laboratory

Name TATHAGATA SUR

Class CSE-UG1 Sec. A1 Roll No. 002310501030

Date of Experiment 04/12/2023 Date of Submission 08/12/2023

Marks Obtained..... Signature of Examiner.....

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Experiment No. 1

Commence at 11:00 AM Completed at 2:00 PM

Name of Teacher concerned Sanjib Pal

TITLE: Verification of Thevenin's theorem and Maximum power Transfer Theorem

OBJECT: (i) To determine Thevenin's equivalent circuit for the given network and verify the theorem.

(ii) To observe the power dissipation with varying load and obtain maximum power condition.

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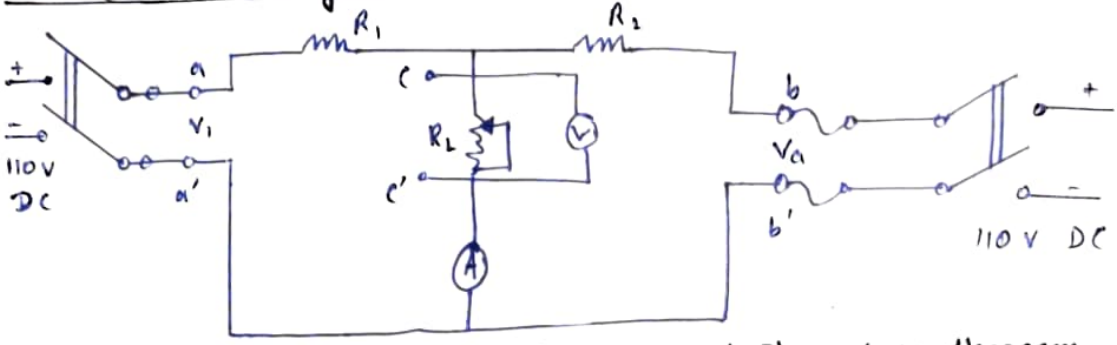
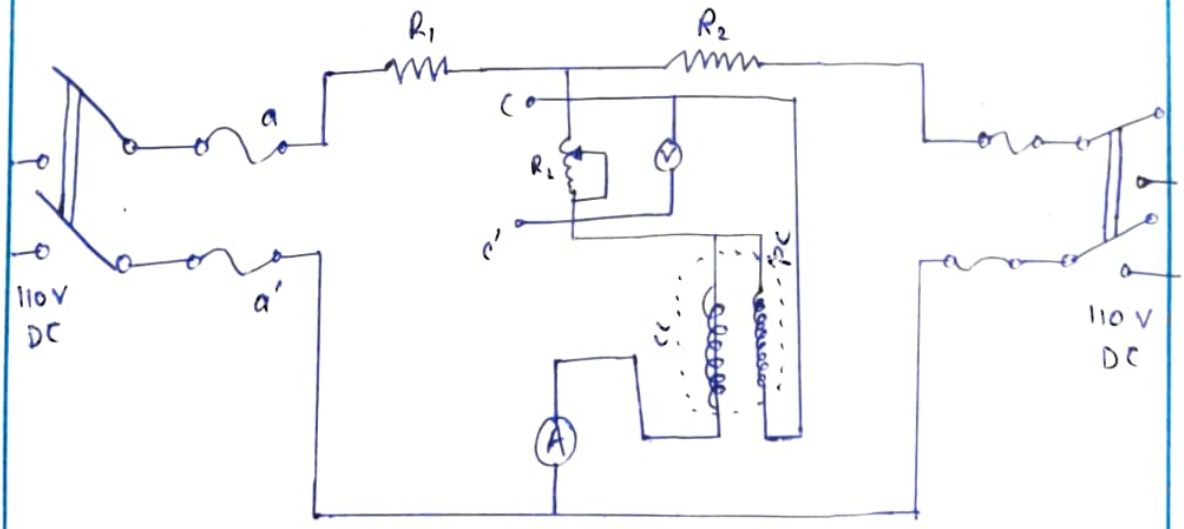
Circuit Diagrams:



(a) Circuit for verification of Thevenin's theorem



(b) Circuit for verification of Maximum Power Transfer Theorem

Apparatus:

Sl. No.	Item	Quantity	Range/Ratings	Maker/Vendor
1.	Rheostat	1×3	3A; 100 Ω ± 10%	Maa Mangala Kolkata
2.	Ammeter	1	2·5 A / 5 A	Automatic Electric Ltd. (a/7 8/ 5123/6)
3.	Voltmeter	1	150 V	Automatic Electric Ltd. (29006)
4.	Wattmeter	1	2·5 A/ 5 A 62·5 V/125 V/150 V	Meco-V (3536)

Observation:

(i) When rheostats (R_1, R_2, R_L) are all at their maximum resistance; current = 1.25 A and voltage = 50 V

(ii) When R_L is removed;
current = 0 A; voltage = 124 V
Hence, Thevenin's equivalent voltage (V_{Th}) = 124 V

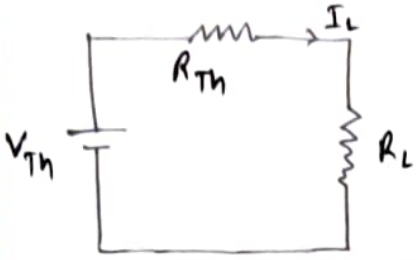
(iii) When sources (aa' and bb') are shorted and 110 V D.C. supply is added to cc'; then current = 2.1 A and voltage = 116 V

(iv) When wattmeter is added and R_L is changed from it's maximum value; the maximum reading in the wattmeter is 71 W.

Report:

1) **Thevenin's Theorem** → According to this theorem; "any linear bilateral network irrespective of its complexities can be reduced into a Thevenin's Equivalent Circuit having Thevenin's open circuit voltage 'V_{Th}' in series with Thevenin's equivalent

resistance 'R_{Th}' along with the Load Resistance R_L.

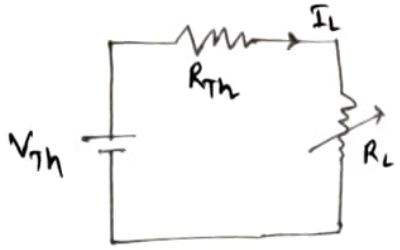


The current I_L through the Load resistor is given by:

$$I_L = \frac{V_{Th}}{R_{Th} + R_L}$$

Maximum Power Transfer Theorem

Acc. to this theorem, "The condition for maximum power flow through Load resistor (R_L) can be achieved when the Load resistance equals the Thevenin's equivalent resistance of the circuit.



Power through $R_L = I_L^2 R_L$

$$= \frac{V_{Th}^2 R_L}{(R_{Th} + R_L)^2}$$

Diff. the above equⁿ and equating it to zero (diff. wrt R_L); we get: $\boxed{R_L = R_{Th}}$

$$\therefore P_{max} = \left(\frac{V_{Th}}{2R_{Th}}\right)^2 . R_{Th} = \frac{V_{Th}^2}{4R_{Th}}$$

2) When sources are short-circuited; then
Current through ammeter = 2.1A; voltmeter reading = 120V

$\therefore$ Thevenin's Equivalent Resistance = $\frac{120}{2.1}\ \Omega = 57.14\ \Omega$

3) Thevenin's Voltage (V_{Th}) = 124 V;
observed Load current (I_L) = 1.25 A

$\Rightarrow$ Load Resistance = $\frac{50}{1.25} = 40\ \Omega$

$\Rightarrow$ Calculated Load Current (I_L) = $\frac{V_{Th}}{R_{Th} + R_L} = \frac{124}{57.14 + 40} = 1.27$ A

$\Rightarrow$ % error in I_L measurement = $\left(\frac{1.27 - 1.25}{1.27} \times 100\right) = 1.57\ \%$

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4) From the expt., observed and calculated I_L values are 1.24 A and 1.27 A. Hence, the values are comparable.

5) At condition of max. power (71 W); the voltage is 62 V and load resistance is 59.04 Ω.

6) Thevenin's voltage = 124 V; Thevenin's Equivalent R_L = 57.14 Ω

a) Calculated max. power = $\frac{124^2}{4 \times 57.14}$ = 67.27 W

From expt., P_{max} = 71 W (values are comparable)

7) By changing the load resistance; the following Power-Voltage-current-Load resistance readings were obtained to get maximum power condition.

Power (W)	Voltage (V)	Current (I)	Load Resistance (Ω)
10	4	2.1	1.904
20	7	2.05	3.414
30	13	1.95	6.666
40	20	1.85	10.81
50	27	1.7	15.88
60	36	1.55	23.22
70	53	1.25	42.4
70	60	1.1	54.54
71	62	1.05	59.04
70	68	1	68
66	74	0.9	82.22
64	78	0.8	97.5

Scale:-

Along X axis,

10 s.d. = 10 Ω

Along Y axis,

10 s.d. = 5 W