ELEMENTS OF ELECTRICAL ENGINEERING
UE24EE141B

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Lecture 16 - Thevenin’s Theorem

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Need for Thevenin’s Theorem

Usually, in a given network we are interested in the response in a particular element.

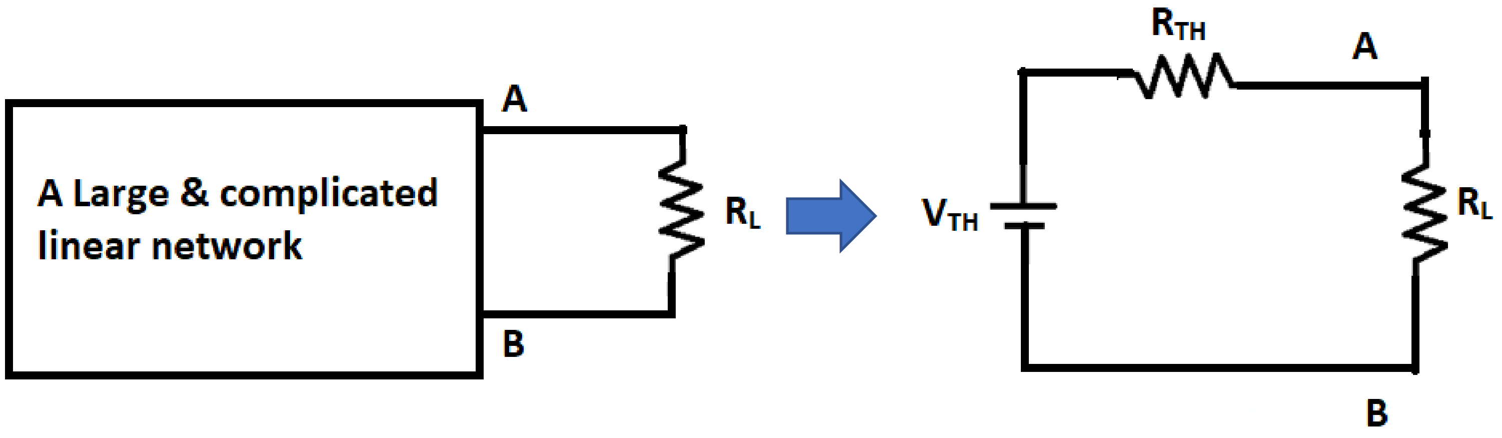
In such cases, remaining part of the network can be replaced with a simple two element series equivalent.

In power amplifier circuits, impedance matching helps in maximum power transfer to the load.

Thevenin's Theorem - Statement

It can be stated as follows:

"A linear network with a large number of independent and dependent sources and resistors between two terminals can be replaced with a simple two element series equivalent in which a voltage source called 'Thevenin's Equivalent Voltage'(V_{TH})is in series with a resistance called 'Thevenin's Equivalent Resistance' (R_{TH})."



Steps to find Thevenin's Voltage & Thevenin's Resistance

Steps to find V_{TH} :

Step 1: Remove the load resistance.

Step 2: Mark voltage across open load terminals and designate it as V_{TH}.

Step 3: Find V_{TH} using KVL or any other technique.

Steps to find R_{TH} :

Step 1: Remove the load resistance.

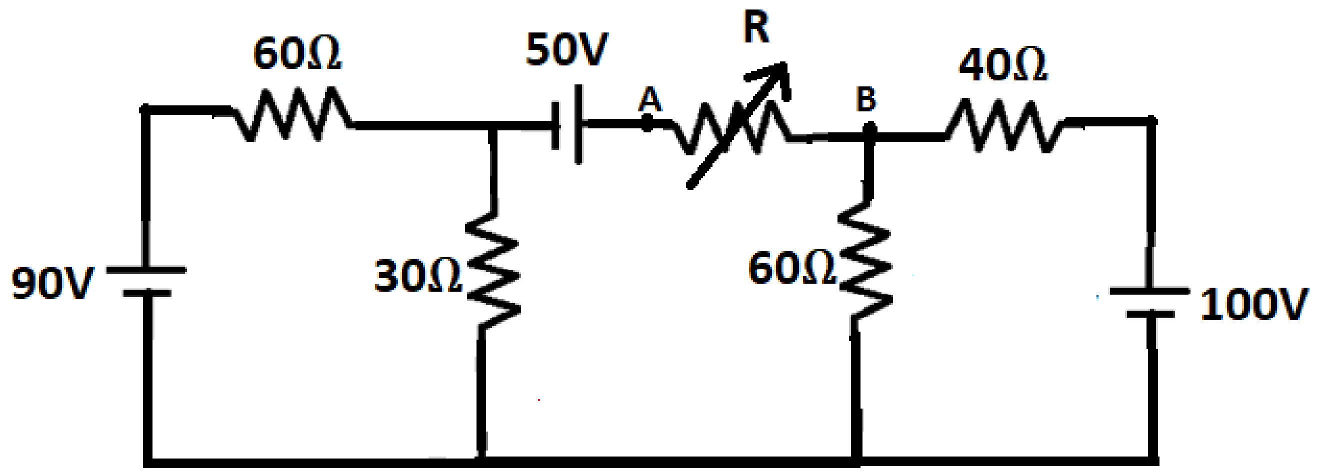
Step 2: Replace all independent voltage sources with short circuit & all independent current sources with open circuit

Step 3: Looking into the open load terminals find the equivalent resistance.

Numerical Example 1

Question:

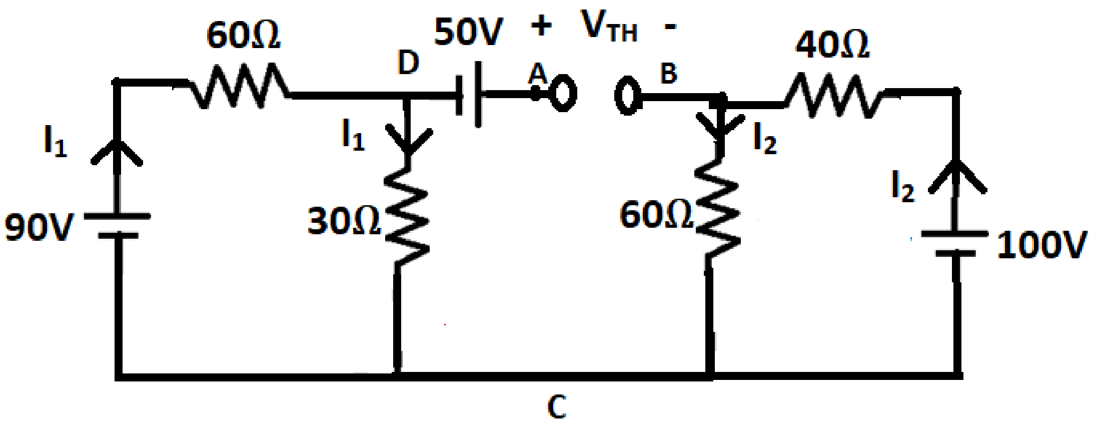
Using Thevenin's Theorem, calculate the range of current flowing through the resistance R, as it varies from 6Ω and 36Ω.



Numerical Example 1

Solution :

Finding V_{TH} :



$I_1 = \frac{90V}{90\Omega} = 1A$; $I_2 = \frac{100V}{100\Omega} = 1A$

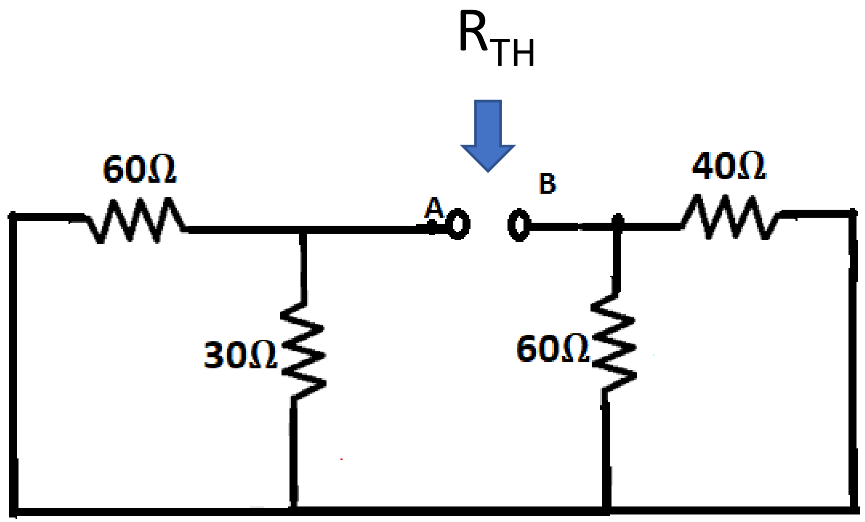
By KVL (DABCD), $+50 - V_{TH} - 60*I_2 + 30*I_1 = 0$

$$V_{TH} = 20V$$

Numerical Example 1

Solution (Continued..) :

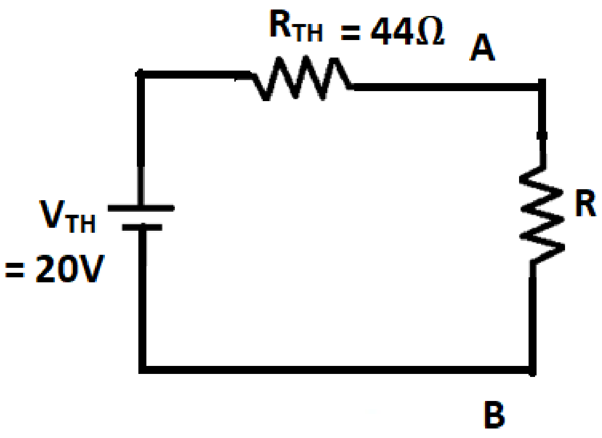
Finding R_{TH} :



R_{TH} = (60Ω II 30Ω) + (60Ω II 30Ω) = 44Ω

Numerical Example 1

Solution (Continued..) :



$$I_L = \frac{V_{TH}}{R_{TH}+R}$$

When R = 6Ω, I_L = 0.4A

When R = 36Ω, I_L = 0.25A

Hence, current through ‘R’ ranges from 0.25A to 0.4A

Text Book & References

Text Book:

"Electrical and Electronic Technology" E. Hughes (Revised by J. Hiley, K. Brown & I.M Smith), 11th Edition, Pearson Education, 2012.

Reference Books:

1. "Basic Electrical Engineering", K Uma Rao, Pearson Education, 2011.
2. "Basic Electrical Engineering - Revised Edition", D. C. Kulshreshta, Tata- McGraw-Hill, 2012.
3. "Engineering Circuit Analysis", William Hayt Jr., Jack E. Kemmerly & Steven M. Durbin, 8th Edition, McGraw-Hill, 2012.

THANK YOU

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