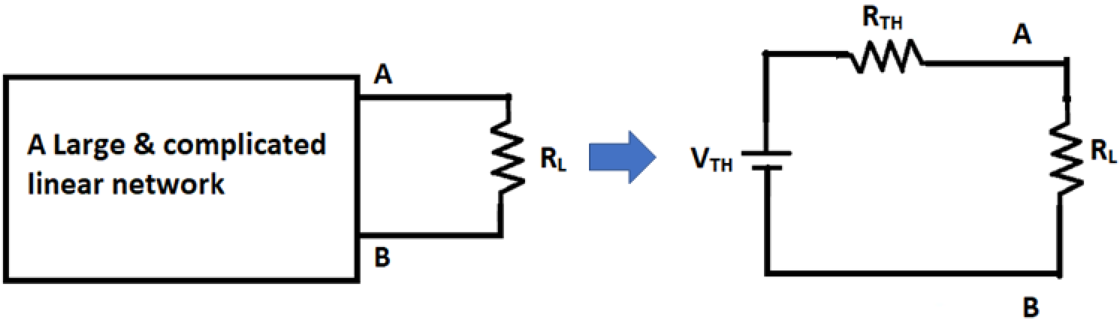
Notes Class- 14

Thevenin's Theorem:

Statement:

"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.

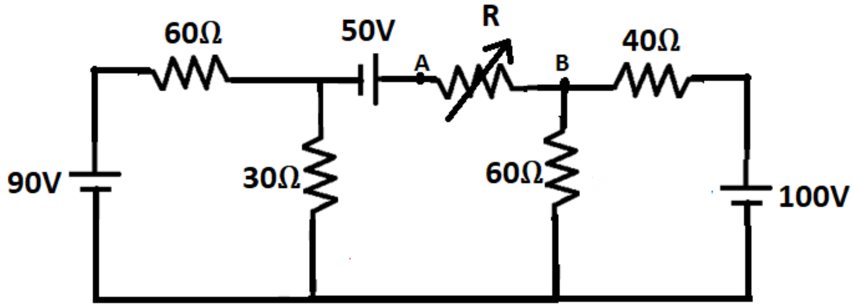
Step 2: Replace all independent voltage sources with short circuit & all independent current sources with open circuit

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

Note: Load resistance is that resistance in which we need to find current or voltage or power response.

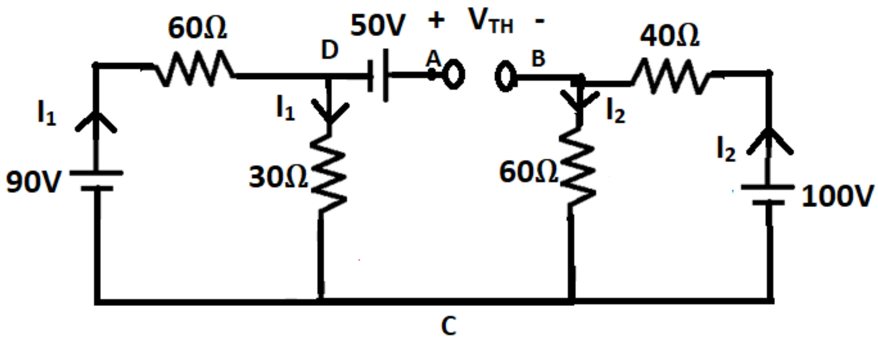
Numerical Example 1:

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



Solution:

Finding V_{TH} :



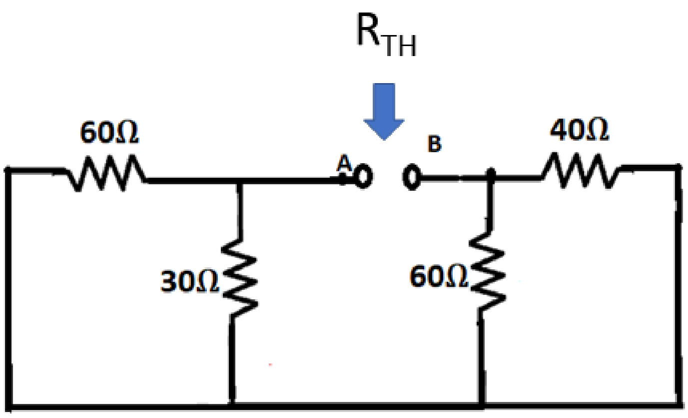
90V - 60Ω - 30Ω makes a simple series path. 100V - 40Ω - 60Ω makes another simple series path.

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

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

$V_{TH} = 20V$

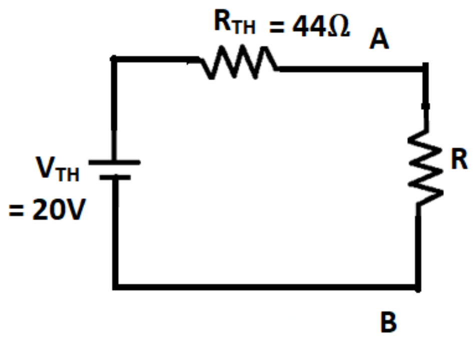
Finding R_{TH} :



Here, (60Ω and 30Ω) are in parallel. Also, (60Ω and 40Ω) are in parallel. These two parallel combinations are in series.

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

Let us now replace the original network with its Thevenin's Equivalent i.e.,



Hence, Load current $I_L = \dfrac{V_{TH}}{R_{TH}+R}$

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.