Thevenin’s Theorem
Introduction

- Thevenin’s Theorem is a very important and useful theorem.
- It is a method for the reduction of a portion of a complex circuit into a simple one.
- It reduces the need for repeated solutions of the same sets of equations.
Thevenin Equivalent Circuit

Any two-terminal linear network, composed of voltage sources, current sources, and resistors, can be replaced by an equivalent two-terminal network consisting of an independent voltage source in series with a resistor.
V-I Characteristic of Thevenin Equivalent

\[ v = V_{Th} - R_{Th}i \]
Finding $V_{Th}$ and $R_{Th}$

- **Open circuit across terminals**
  
  $i = 0, \ v = v_{oc} = V_{Th}$

Calculate the open-circuit voltage in the original network, $v_{oc}$

$V_{Th} = v_{oc}$
Finding $V_{Th}$ and $R_{Th}$ – Cont’d

- Short circuit across terminals

$v = 0,\quad i = i_{sc} = \frac{V_{Th}}{R_{Th}}$

Calculate the short-circuit current in the original network, $i_{sc}$

$$R_{Th} = \frac{V_{oc}}{i_{sc}}$$
Thevenin Equivalent - Example

Find the Thevenin equivalent with respect to terminals a,b.
Alternative Method of finding $R_{Th}$
-- for circuits containing only independent sources

1. Set all independent sources to zero
2. Find equivalent resistance $R_{eq}$ of the dead circuit between the terminals

\[ R_{Th} = R_{eq} \]
Alternative Method of finding $R_{Th}$

--- for circuits containing dependent sources

1. Set all independent sources to zero
2. Apply either a test voltage source $v_0$ (or a test current source $i_0$) to the terminals
3. Calculate $i_0$ (or $v_0$)

\[ R_{Th} = \frac{v_0}{i_0} \]
Find the Thevenin equivalent of the following circuit. If a 10Ω resistor is connected between the terminals, what current will flow in it?