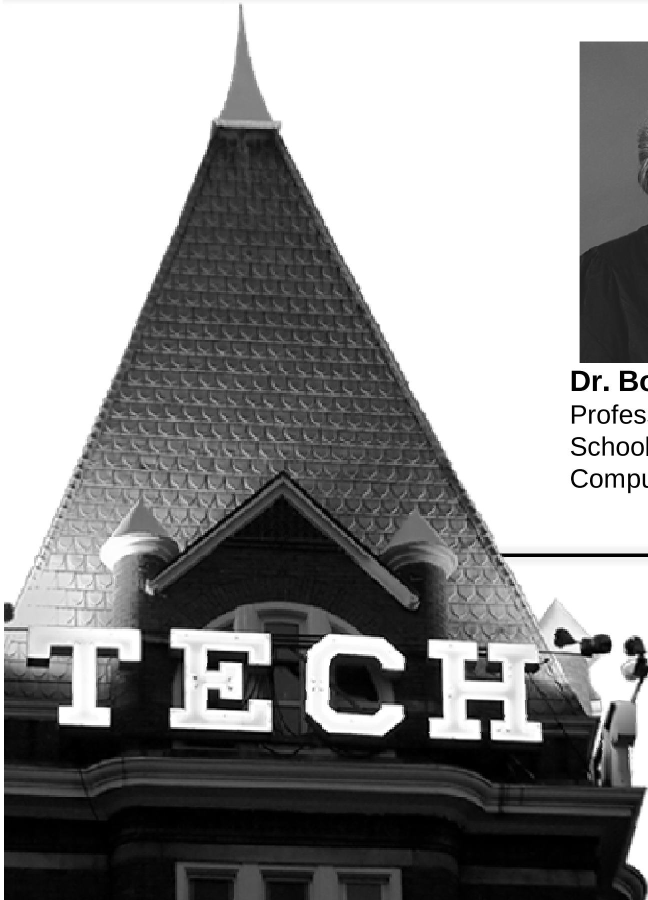


Linear Circuits

Dr. Bonnie Ferri
Professor and Associate Chair
School of Electrical and
Computer Engineering

An introduction to linear electric circuit elements and a study of circuits containing such devices.

Georgia Institute of Technology

Systematic Solution Methods: Part 2

Dr. Bonnie Ferri
Professor and Associate Chair
School of Electrical and
Computer Engineering

Introduce several ways of obtaining circuit equations.

Module 2: Resistive Circuits

- Resistance
- Kirchhoff’s Laws
- Resistors
- Superposition
- Systematic Solution Methods
- Maximum Power Transfer
- Application: Sensors

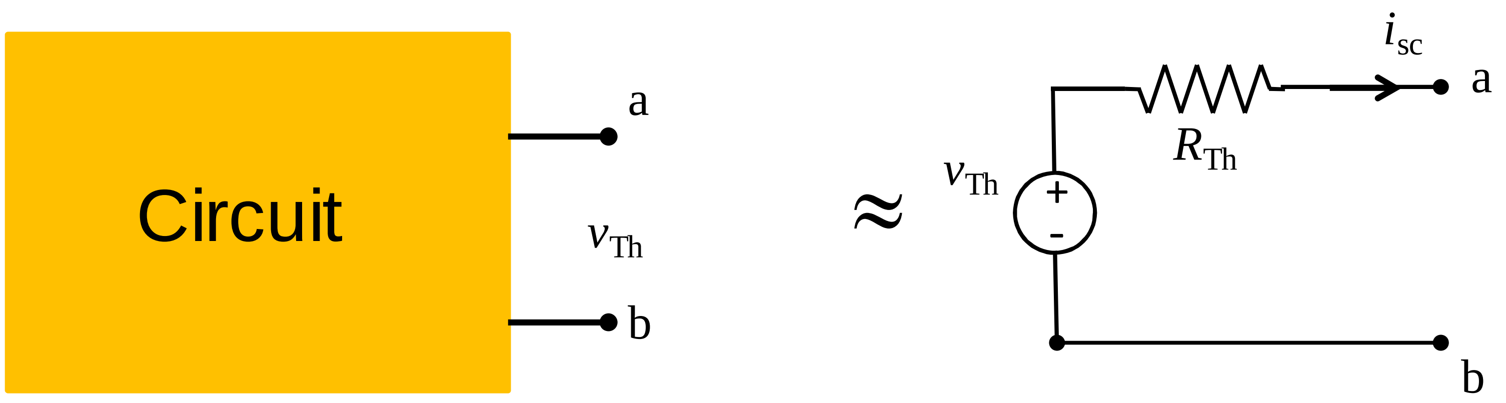
Lesson Objective

- Demonstrate
  - Thévenin equivalent and Norton equivalent circuits
  - Source transformations

Systematic solution Methods

Method	Summary	When to Apply
Mesh Analysis	KVL to obtain simultaneous equations for currents	• Multiple currents are needed • Current sources are present
Node Analysis	KCL to obtain simultaneous equations for voltages	• Multiple voltages are needed • Voltage sources are present
Thévenin and Norton Equivalent Circuits	Simple equivalent circuits, source transformations	• Intermediate values not important; only output voltage or current

Thévenin Equivalent

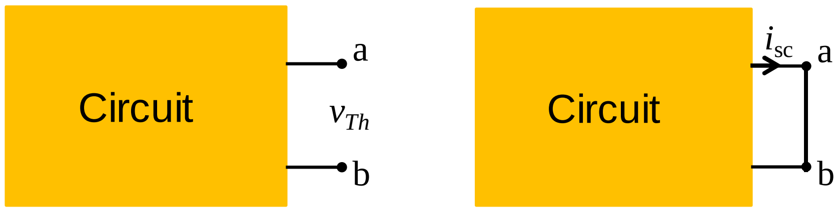


Replace circuit with equivalent resistance and voltage source

Thévenin Equivalent Circuit

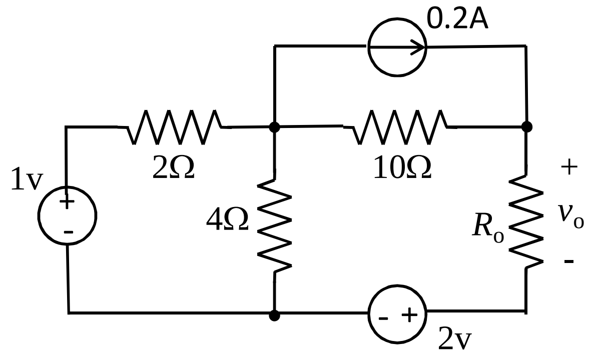
- $\boldsymbol{v_{Th}}$: open circuit across a-b and find $v_{ab} = \boldsymbol{v_{Th}}$
- $\boldsymbol{i_{sc}}$: short circuit across a-b and find $\boldsymbol{i_{sc}}$

$$v_{Th} = R_{Th}\, i_{sc}$$

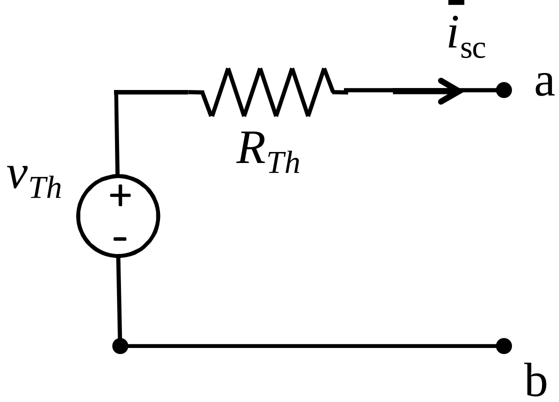


- $\boldsymbol{R_{Th}}$: circuit resistance with voltage sources shorted and current sources open circuited (when no dependent sources are present)

Thévenin Equivalent Example



Norton Equivalent Circuit



Thévenin equivalent circuit

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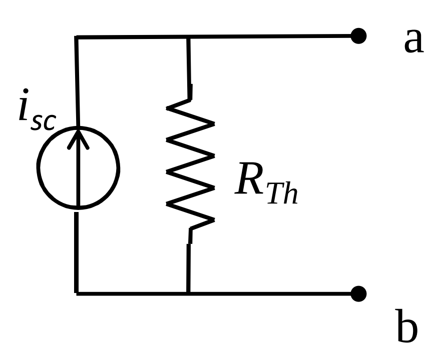
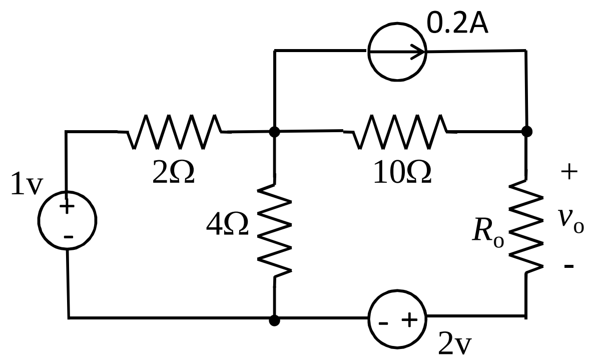


Norton equivalent circuit

Source Transformation: these configurations are interchangeable in a circuit

Source Transformation Example



Summary

- Mesh and node analysis
  - Systematic ways to find independent simultaneous equations
- Thévenin and Norton methods
  - Replace most of the circuit with a simple equivalent circuit
  - Source transformations
- Extra worked problems are given on these methods

Next Lesson

- Maximum Power Transfer
  - Uses Thévenin equivalent circuit to find the load to maximize power delivered