Chapter 4 - Methods of Analysis of Resistive Circuits

Lecture 10
Section 4.3

MEMS 0031 Electrical Circuits

Mechanical Engineering and Materials Science Department
University of Pittsburgh

Student Learning Objectives

At the end of the lecture, students should be able to:

- Apply Node Voltage Analysis (NVA) to circuits with independent current and voltage sources

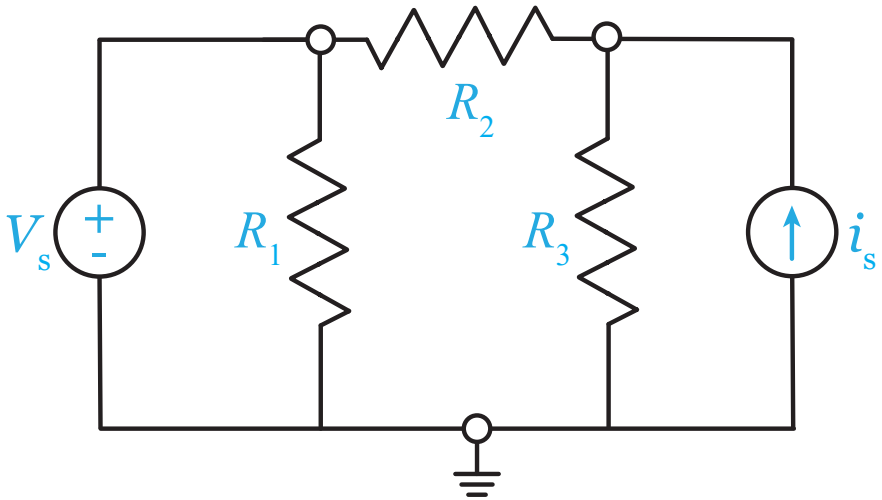
NVA with Independent VS

- By adding an independent VS, we remove a degree of freedom, for we are prescribing a node voltage
- Thus the number of KCL equations is as follows:

$$\#\,\text{KCL Eqns.} = N - \#\,\text{VS} - 1$$

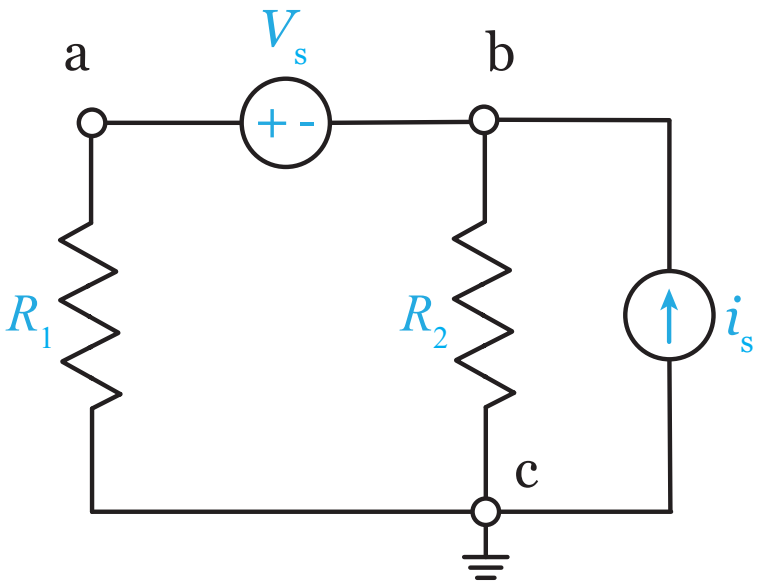
- Additionally, we will introduce the concept of a "supernode" - two nodes connected by a VS

Example #1



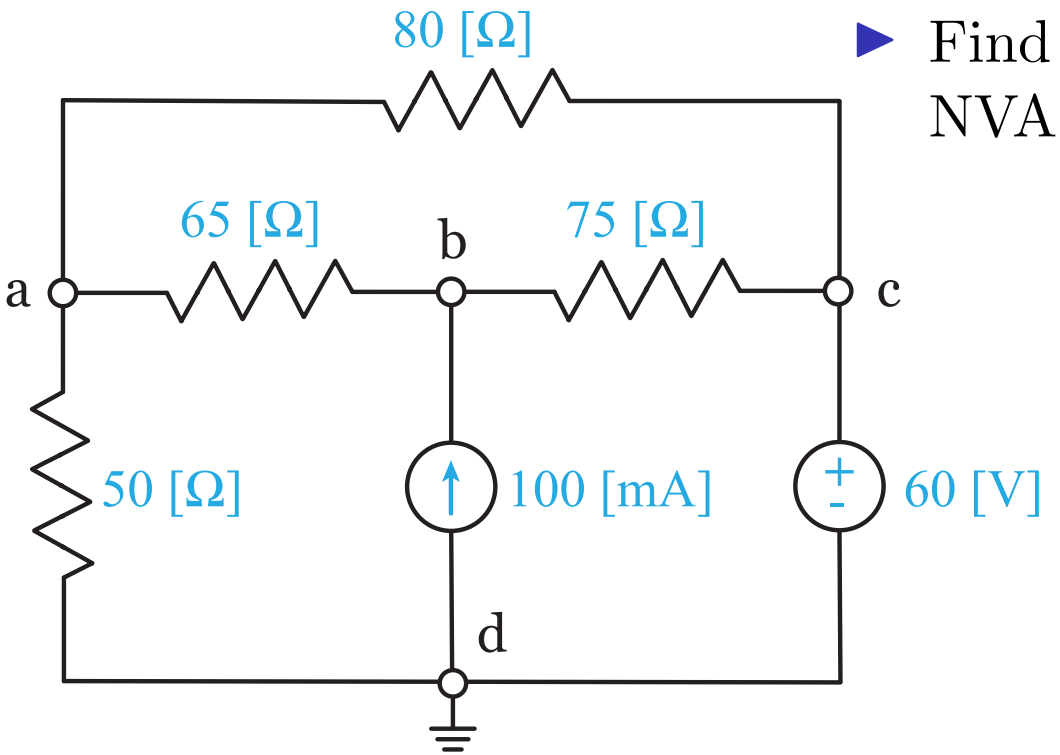
- Use NVA to determine the node voltages, symbolically:

Example #2 - Supernode



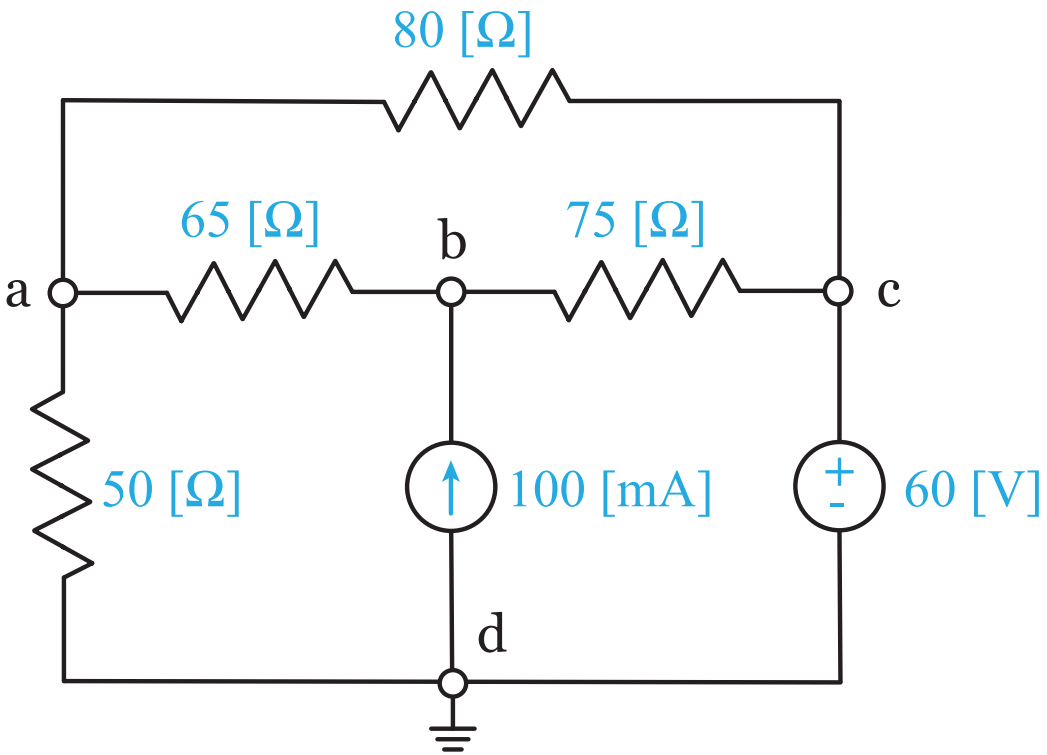
- Determine the voltage at node b:

Example #3



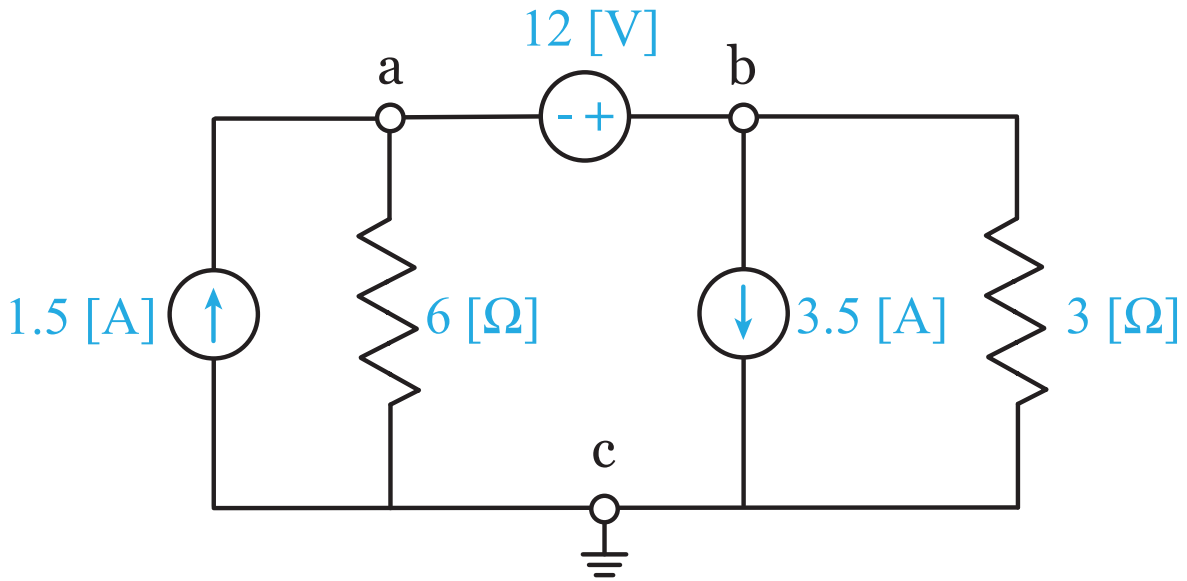
- Find V_a and V_b via NVA:

Example #3

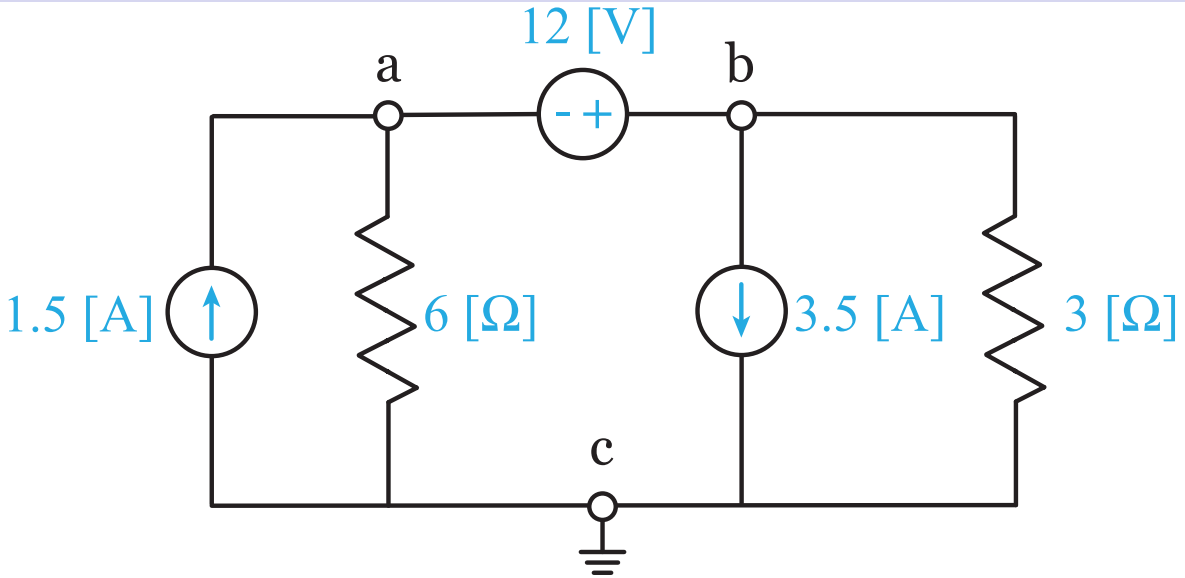


Example #4

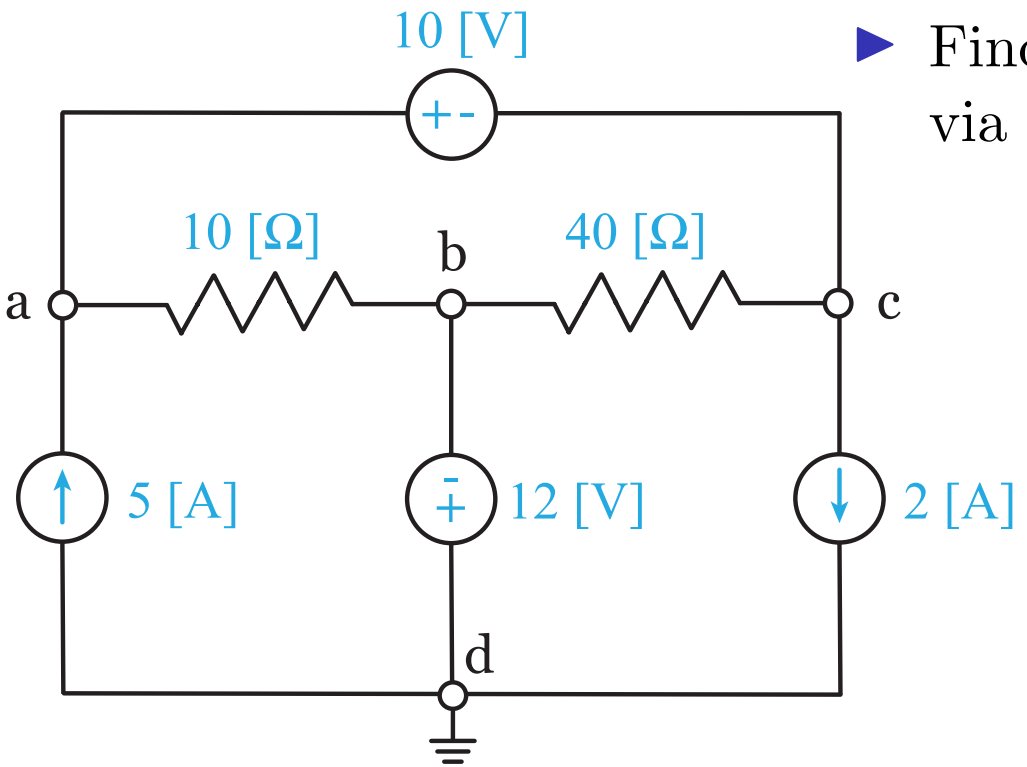
- Find node voltages via NVA:



Example #4

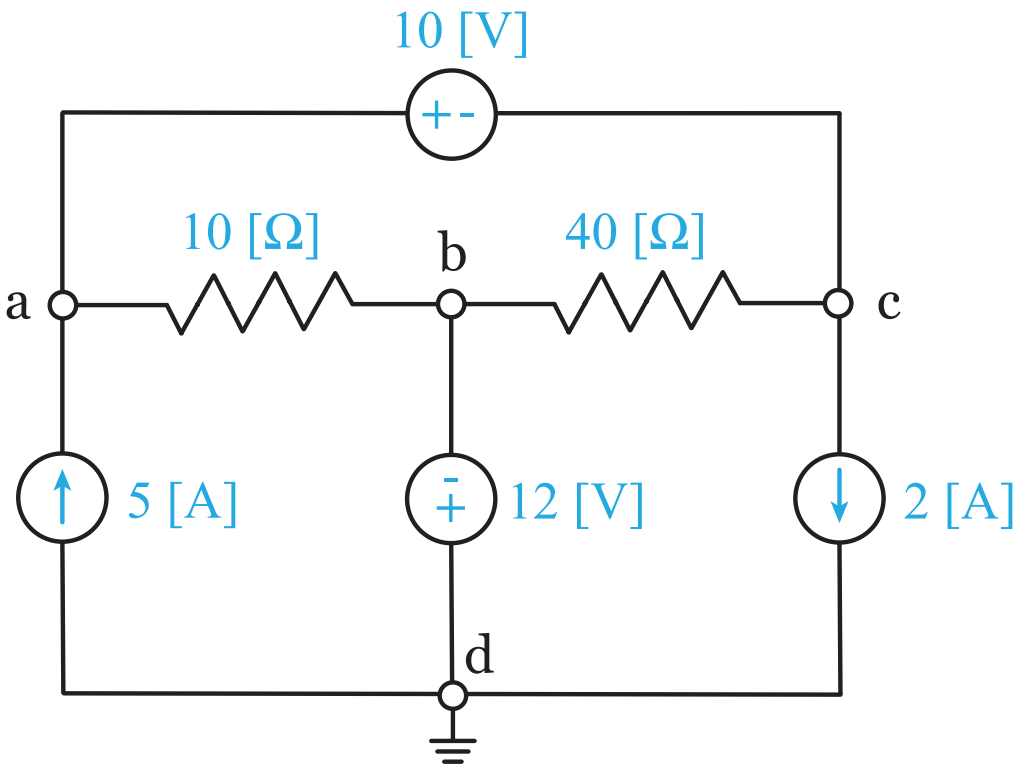


Example #5



- Find node voltages via NVA:

Example #5



Student Learning Objectives

At the end of the lecture, students should be able to:

- Apply Node Voltage Analysis (NVA) to circuits with independent current sources
  - NVA requires the sole use of KCL. We construct $N - 1 - \#\text{VS}$ KCL equations, applied at non-zero and non-specified, and relate the currents to voltages using Ohm's law.
  - A voltage source between two non-zero nodes creates a supernode, i.e. an equation that relates two node voltages - apply KCL here!
  - A voltage source between a non-zero and zero-voltage nodes specifies the non-zero node voltage.

Suggested Problems

At the end of the lecture, students should be able to:

- 4.3-1, 4.3-2, 4.3-3, 4.3-4, 4.3-5, 4.3-6, 4.3-7, 4.3-10, 4.3-12