

Chapter 4 - Methods of Analysis of Resistive Circuits

Lecture 9 Section 4.2

MEMS 0031

Learning Objectives

4.2 Node Voltage
Analysis with
Independent
Current Sources

Summary

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 sources

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- ▶ So far, we've used KCL, KVL and Ohm's law to solve for the behavior of a circuit
- ▶ We want a formal, automated way to analyze circuits
- ▶ NVA uses strictly KCL and Ohm's law
- ▶ We will construct “node voltages” - based upon N nodes we will have $N-1$ KCL equations

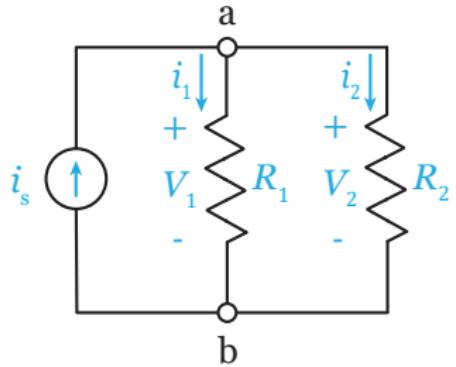
Learning Objectives

4.2 Node Voltage Analysis with Independent Current Sources

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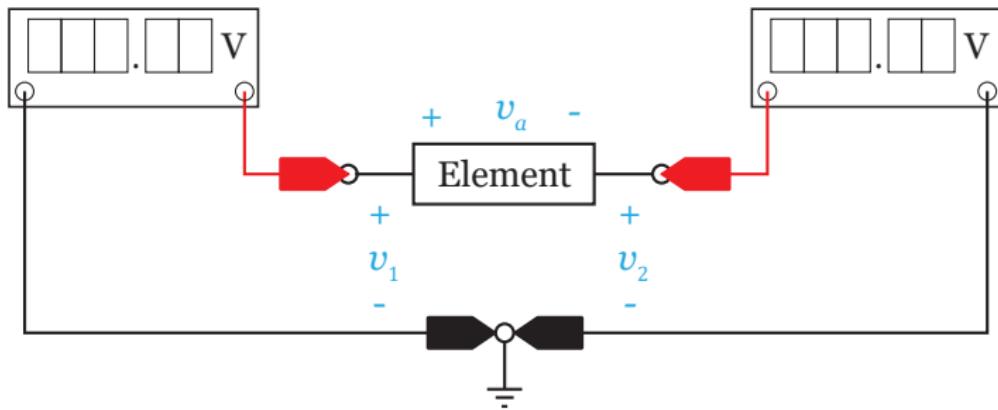
NVA



- ▶ Consider the following circuit: How many nodes do we have?



- ▶ Finding the voltage across an element:



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- ▶ Finding the current through a resistive element:



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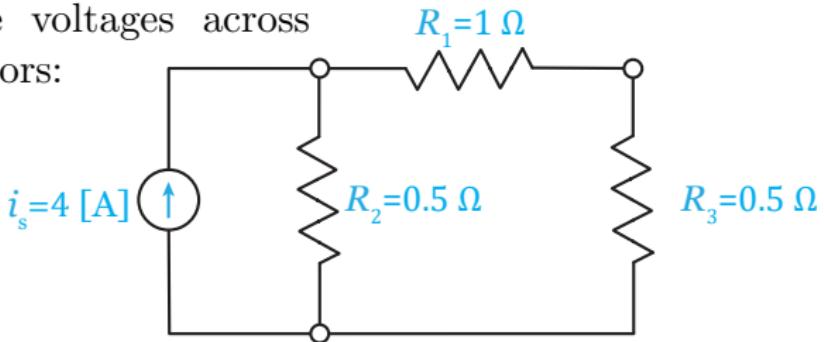
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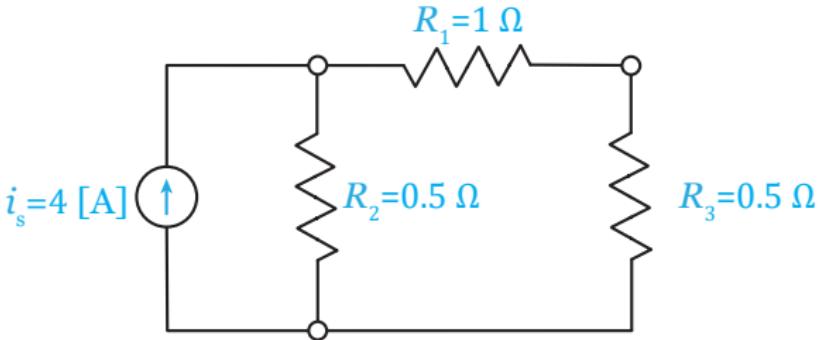
Example #1

Find the voltages across the resistors:



Example #1

Solution:



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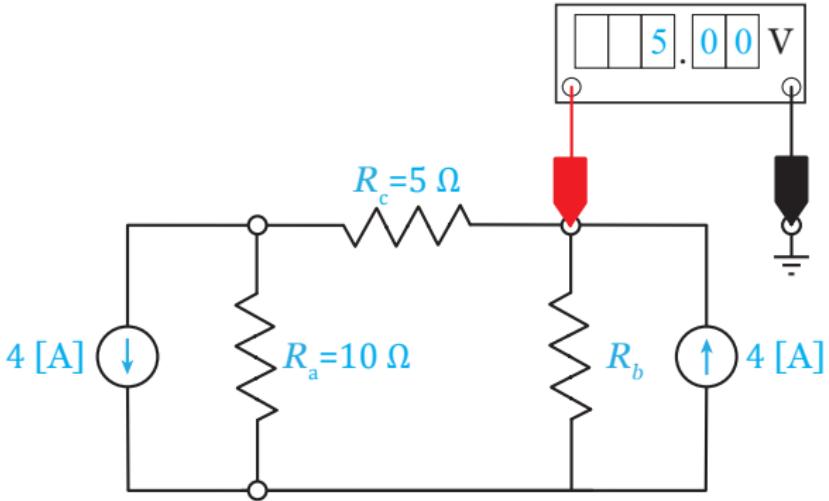
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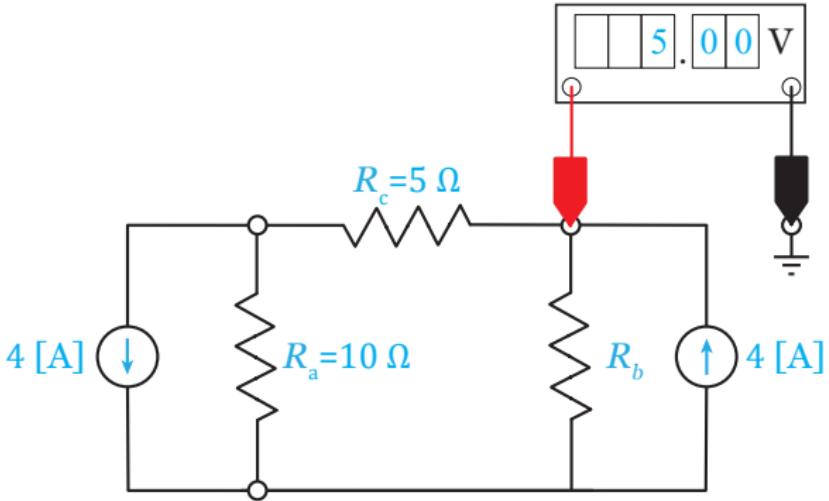
Example #2

Find R_b :



Example #2

Solution:



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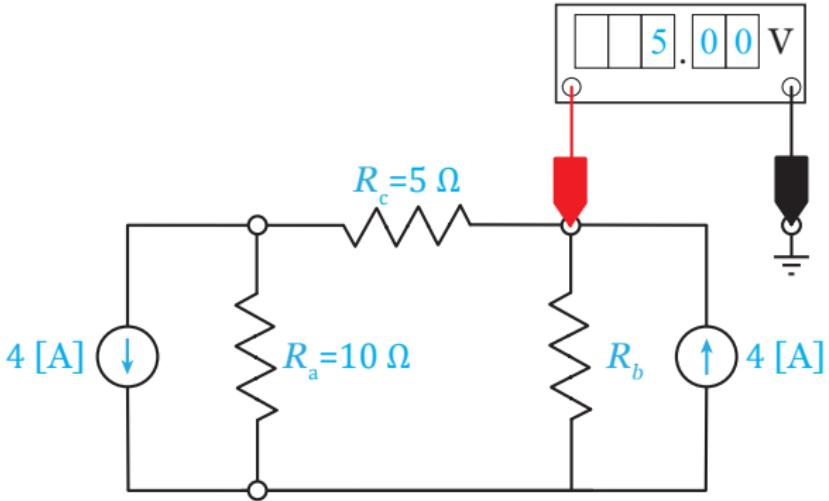
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Example #2

Solution:



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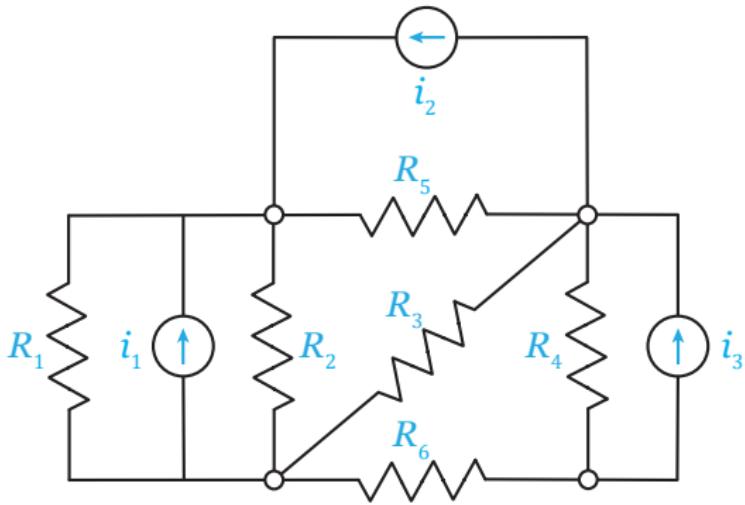
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Example #3

- Solve for the node voltages of the given circuit given $i_1=1$ [A], $i_2=2$ [A], $i_3=3$ [A], $R_1=5$ [Ω], $R_2=2$ [Ω], $R_3=10$ [Ω], $R_4=4$ [Ω], $R_5=5$ [Ω] and $R_6=2$ [Ω]



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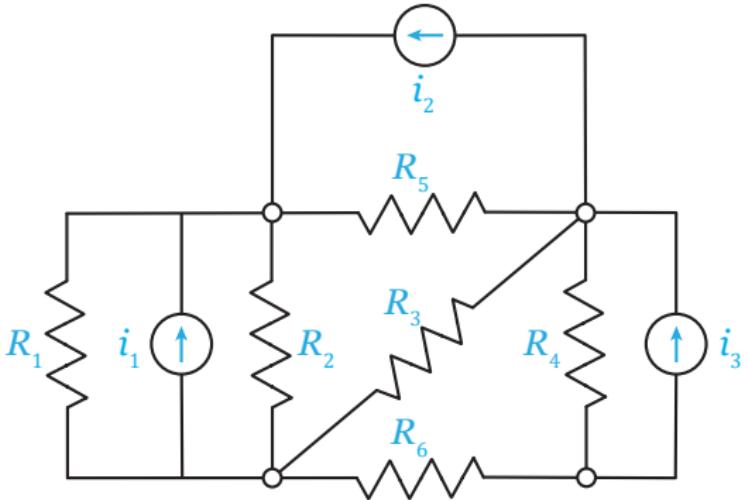
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Example #3

Solution:



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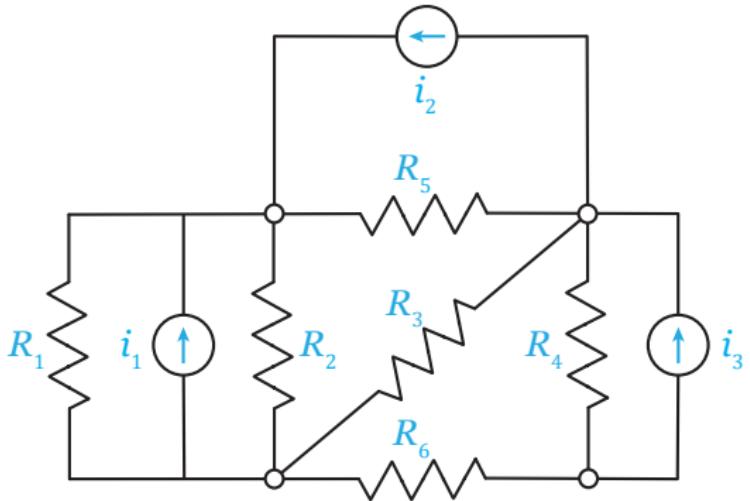
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Example #3

Solution:



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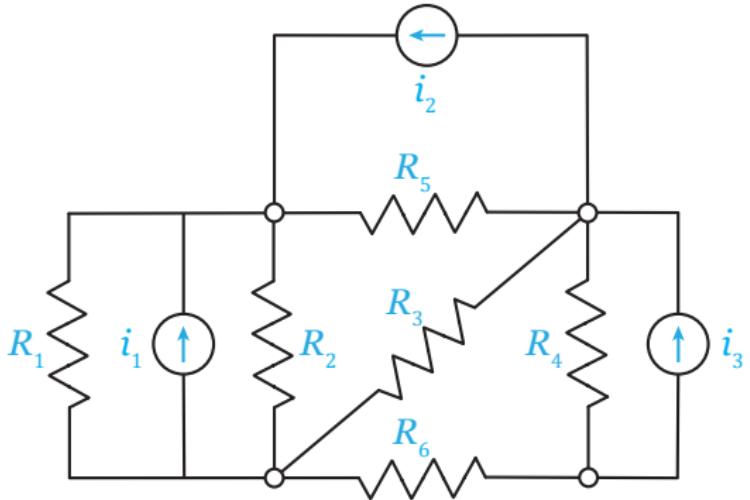
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Example #3

Solution:



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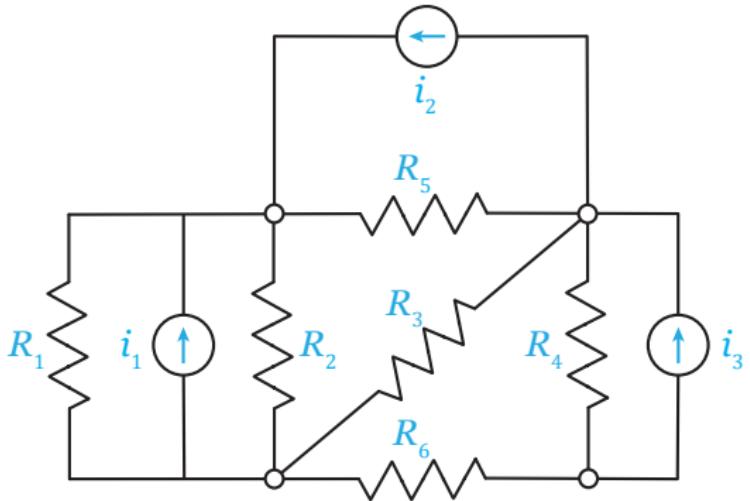
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Solution:



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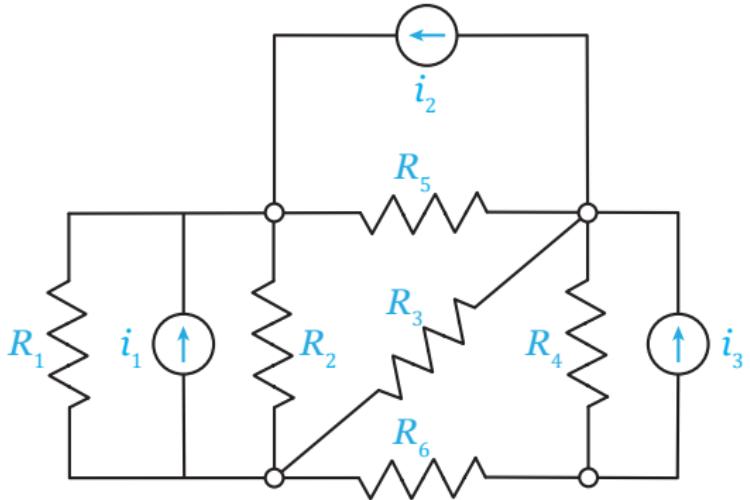
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Example #3

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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 $N - 1$ KCL equations, applied at non-zero, and relate the currents to voltages using Ohm's law.

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Suggested Problems

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

- ▶ 4.2-1, 4.2-2, 4.2-3, 4.2-4, 4.2-5, 4.2-6, 4.2-7

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