Chapter 4 -
Methods of Analysis
of Resistive Circuits

MEMS 0031

Learning Objectives

4.4 Node Voltage
Analysis with
Independent
Voltage Sources

Summary

Chapter 4 - Methods of Analysis of Resistive Circuits

Lecture 11

Section 4.4

MEMS 0031 Electrical Circuits

Mechanical Engineering and Materials Science Department
University of Pittsburgh

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Student Learning Objectives

Chapter 4 -
Methods of Analysis
of Resistive Circuits

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Learning Objectives

4.4 Node Voltage
Analysis with
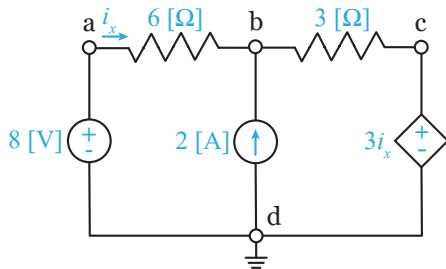Independent
Voltage Sources

Summary

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

► Apply Node Voltage Analysis (NVA) to circuits with dependent sources

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NVA with Independent VS

▶ By adding an dependent source, we must express behavior (voltage) in terms of node voltages.

▶ The number of KCL equations still holds as:

$$\# \,\text{KCL Eqns.} = N - \# \,\text{VS} - 1$$
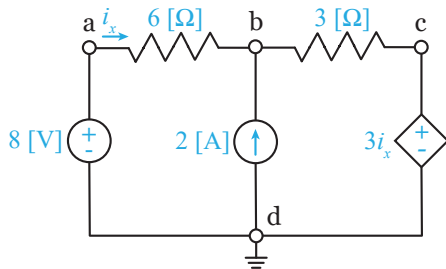
▶ "Supernode" formulation is still valid

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Example #1

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Summary

► Use NVA to de-
termine the node
voltages:

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Example #1

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4.4 Node Voltage
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Voltage Sources

Summary

► <u>Solution</u>:

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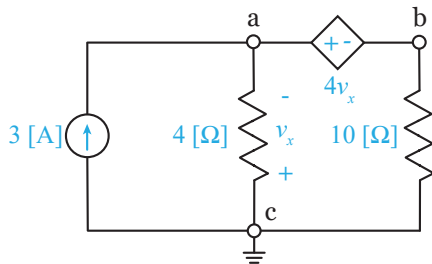# Example #2

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Learning Objectives

4.4 Node Voltage
Analysis with
Independent
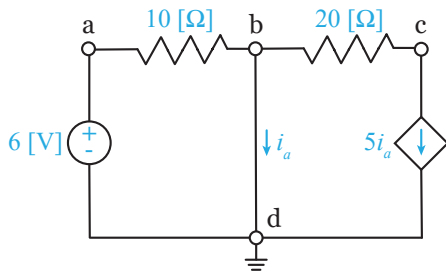Voltage Sources

Summary

▶ Determine the voltage at a and b:
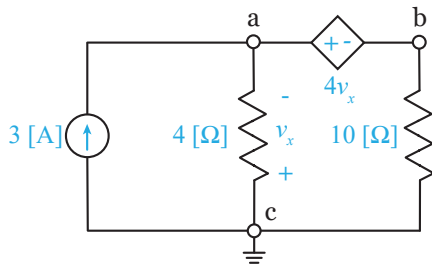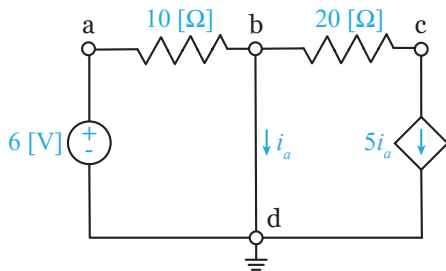
©Barry, 2020

Example #2

▶ <u>Solution</u>:

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Example #3

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4.4 Node Voltage
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Summary

▶ Determine all unknowns:

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Example #3

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Learning Objectives

4.4 Node Voltage
Analysis with
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Summary

► <u>Solution</u>:

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Student Learning Objectives

Chapter 4 -
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Learning Objectives

4.4 Node Voltage
Analysis with
Independent
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Summary

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 $N - 1 - \#VS$ KCL equations, applied at non-zero and non-specified, and relate the currents to voltages using Ohm's law.
  - A voltage source (independent and dependent) 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.

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Suggested Problems

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

- ▶ 4.4-1, 4.4-2, 4.4-3, 4.4-4, 4.4-5, 4.4-6, 4.4-7, 4.4-13, 4.4-14

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