ECE 203

Circuits I

Nodal Analysis

Chapter 3 Nodal and Loop Analysis

Will begin looking at two new analysis methods for your toolbox

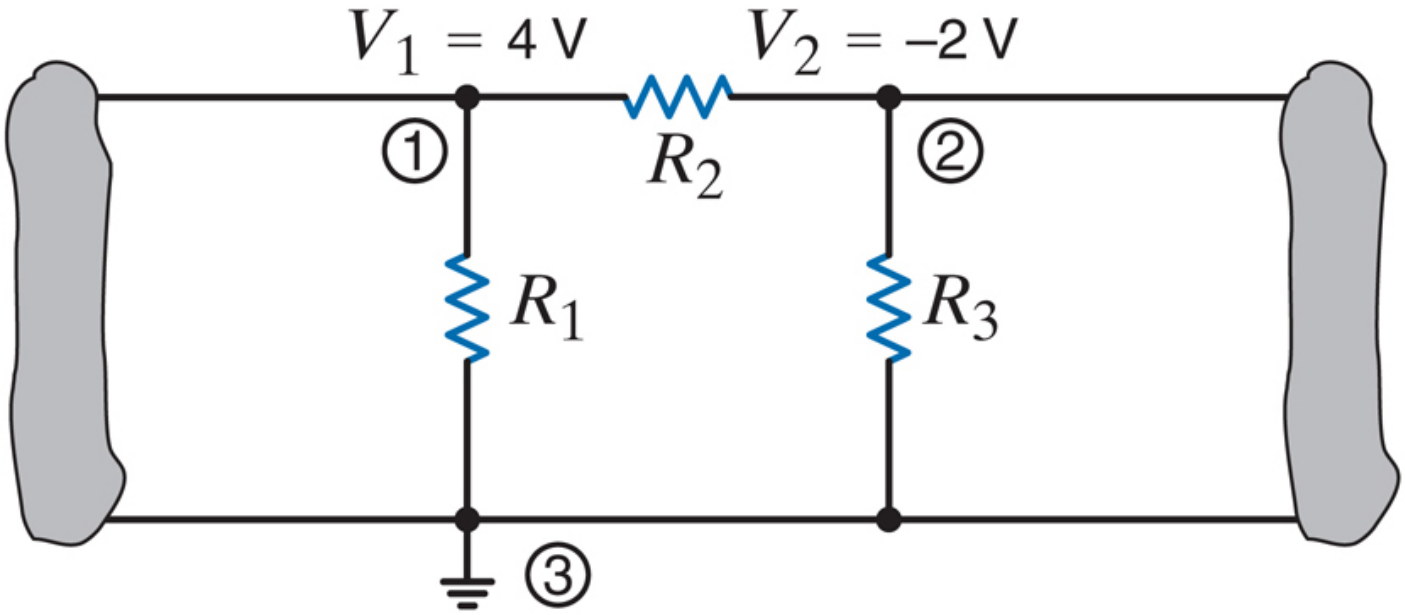
Both are based on linear algebra techniques

Nodal Analysis

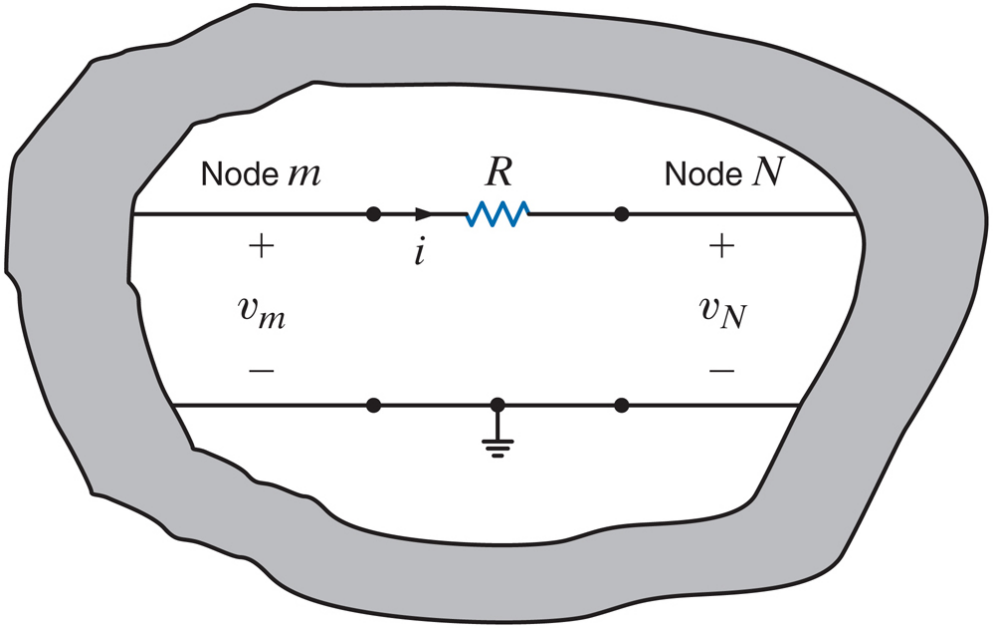
- **The variables are node voltages**
- **Node voltages are defined with respect to a common point (ground, *i.e.* zero potential)**
- **Ground is usually the node with the largest number of branches**
- **We select our variables as being positive with respect to ground (although they may turn out to be negative)**
- **Once the node voltages are known, any circuit parameter can be calculated**

The Concept of Node Voltage

- V_1 is 4V. What does this mean? With respect to what?
- V_2 is -2V. What does this mean? With respect to what?
- What is the voltage at node 1 with respect to node 2?
- What is the voltage at node 2 with respect to node 1?



General Rule



$$i = \frac{v_m - v_N}{R}$$

General Rules

- For nodal analysis, we employ KCL
- One node is designated as GND
- Therefore in an N node circuit, there will be N-1 unknown variables (node voltages)
- KCL gives us N-1 linearly independent equations
- Solution of KCL equations gives all node voltages with respect to GND (reference)
- Any other circuit parameter can be determined by the node voltages

Step-by-step

1) Establish where each node is; must have a reference node
2) Assign the voltage variables at each node; for example, V_1, V_2, …
3) Write the equations for KCL at each node
4) Use Ohm's law to rewrite the equation in terms of voltages and resistances (You should have the same number of equations as unknowns)

Step-by-step continued

5) Solve for the unknown voltages (you have a few choices of how to do this)
6) Use Ohm's law to solve for unknown currents

Examples: