

## Test #2 Overview

### Material covered

- The following chapters and sections in Electric Circuits, 9<sup>th</sup> Edition by Nilsson
  - Chapter 4, Sections 1 - 8 (node and mesh equations)  $\approx 67\%$
  - Chapter 5 (operational amplifiers)  $\approx 33\%$
- Related homework assignments: HW #4-6
- Typical format:
  - 2 node equation problems
  - 2 mesh equation problems
  - 2 op amp problems

### Node Equations

Node voltages are *relative voltages* that depend on the reference (ground)

Be able to find component current, voltage, or power using node voltages

# Node Equations = # Nodes - # Voltage Sources - 1

In general, write node equations at:

- All nodes not adjacent to a voltage source or to the ground node
- All supernodes

Supernodes - needed when the circuit contains voltage sources that are not adjacent to the ground

Dependent sources - redefine the control variable in terms of node voltages

### Mesh Equations

Limited to planar circuits

Be able to find component current, voltage, or power using mesh currents

# Mesh Equations = # Meshes - # Current Sources

In general, write mesh equations at:

- All meshes without current sources
- All supermeshes

Supermesh - needed when the circuit contains internal current sources (not on the outer edge)

Dependent sources - redefine the control variable in terms of mesh currents

### Operational Amplifiers

Ideal amplifiers only - no models

Basic rules for analyzing an ideal op amp:

- $V^+ = V^-$
- $I^+ = I^- = 0$
- All voltages are node voltages (w.r.t. a common ground), so rely on node equations

Two common op-amp limitations:

- $V_o(\max) = V_{\text{sat}}$  is limited by the supply voltage,  $\pm V_{\text{DC}}$ .
- $I_o(\max)$  is generally specified by the manufacturer

Key analysis tool: node equations

Do not memorize any equations for common op amp configurations (such as  $V_o = -(R_F/R_1)V_{\text{in}}$  for the inverting amplifier).

You do not need to know the dependent source model for an op amp (although we will use it in PSPICE).

**Study hint:**

- Work enough problems so that you become fast at solving them.
- Pick any of the node or mesh equations problems in the text and try solving them twice: once with node equations and once with mesh equations.