EE 202L
Class #3
Last Time …

Series Resistance Adds
- Shared Current
- One Common Node, Only Two Connections

Parallel Conductance Adds
- Shared Voltage
- Two Common Nodes

\[ R_{eq} = R_1 \parallel R_2 = \frac{R_1 R_2}{R_1 + R_2} \]
Voltage Divider

\[ v_x = V_s \frac{R_x}{\Sigma R} \]

Current Divider

\[ i_x = I_s \frac{G_x}{\Sigma G} \]
Determine \( v_x \)
Linear Circuits (One Source)

**Unit-Output Method**
- Assign Unity Value to Some Unknown Variable
- Find Consistent Source Value (Mark-Up Method)
- $K = 1 / \text{Source Value}$
- Output $= K \times \text{Actual Source Value}$

**Linearity**
$$i = K \ V_s + B$$

Power Conserved!
Unit-Output Method Example

\[ \begin{align*}
V_s & = 12 \\
K & = 4 \frac{109}{4} \\
v_x & = \frac{12}{K} = \frac{12}{4} = 3
\end{align*} \]
Linear Circuits (Multiple Sources)

Superposition Method

- Turn Off All Sources Except One
- Find Response
- Repeat For Each Source
- Add Results

Linear Circuit

\[ i = K_1 V_s + K_2 I_s \]

Linearity

\[ I_s = 0 \rightarrow i = K_1 V_s \]
\[ V_s = 0 \rightarrow i = K_2 I_s \]
Determine $i_x$
Superposition Method Example

Voltage Source Off

\[ R = 5 + 30 \parallel 15 = 15 \]

\[ \begin{align*}
i_y &= 15 \times \frac{1/15}{1/15 + 1/10} = 6 \\
i_x &= 6 \times \frac{1/15}{1/15 + 1/30} = 4
\end{align*} \]
Superposition Method Example

Current Source Off

\[-i_x = \frac{50}{15 + 30 \parallel 15} = 2\]

Complete Response

\[i_x = 4 + (-2) = 2\]
Exercise 1

Determine $v_x$
Equivalent Source Actions

\[ v = V_a - i R \]

\[ v = \left( \frac{V_a}{R} - i \right) R \]

\[ = V_a - i R \]
Source Substitutions

Do Not Transform Dependent Sources
Source Substitution Example
Source Substitution Example
Put Everything Together

\[ v_x = 6 \times \frac{1}{2} = 3 \]
Exercise 2

Determine \( i_x \)
Industry Standard Circuit Analysis Program

- UC Berkeley - 1973 (Fortran)
- PSpice, HSpice, TSpice, …
SPICE Input Options

Statement List

Schematic Capture
General SPICE Format

* Comment
Netlist
Model Statements (Not Needed for EE 202L)
Commands
.end
SPICE Netlist - Assign Nodes

[Electrical circuit diagram with labeled nodes and voltages]
Netlist

V1  1  0  8  
R1  1  2  1  
R2  2  0  2  
V2  3  2  2  
R3  3  0  3  
I1  2  4  2  
R4  2  4  6  
V3  4  0  4  

Commands

.dc V1 8 8 0.1  (sweep)
.print dc v(2)