Comparison of Node-Voltage and Mesh-Current Analytical Techniques
Active Learning Example for Circuits VCP

Overview: When introduced to the different analytical techniques, students may not see the advantage of one method versus another. Often, students will adopt a 'favorite' method and always use that one, regardless of the circuit layout. In this activity students will identify key differences between two methods, and which method may be more advantageous given a particular circuit. Perhaps even more importantly, by the end of the activity, they will learn to *think* about the circuit before "jumping right in" and analyzing it.

Summary of Activity: Students are asked to work in pairs and groups of 4 to analyze resistive dc circuits using two different methods (Node-Voltage Analysis and Mesh-Current Analysis). Upon completion of the activity, they should be able to better judge which technique is most appropriate to use given a particular circuit.

Appropriate audience: This activity would be appropriate after the Node-Voltage and Mesh-Current analytical techniques have been introduced and the students have had some practice applying both techniques, but likely not proficient at them.

<u>Activity (Groups of 4):</u>
Students are presented with two circuits, Circuit 1 and Circuit 2 (*Example circuits are shown on the next page*).

Students A and B work together, using Mesh-Current Analysis on both Circuit 1 and Circuit 2 to determine the voltage at each node and the current through each of resistors.

Students C and D work together, using Node-Voltage Analysis on both Circuit 1 and Circuit 2 to determine the voltage at each node and the current through each of resistors.

After analyzing the circuits, the four students gather together to share their results. They should:

     1) Determine if they calculated the same voltage values and current values.

     2) Determine which method they have the most confidence in for each circuit, if they have different results (likely more confidence in Node-Voltage Analysis for Circuit 1 and Mesh-Current Analysis for Circuit 2 since values are 'known'?) *(instructor may want to provide the correct values at this point)*

     3) Discuss which method was "easier" for each circuit - and **<u>WHY</u>** that might be.

After they have discussed amongst themselves, instructor can lead a discussion about the characteristics of each circuit, and solicit ideas on why one technique was easier/better than the other. Try to identify key properties for each circuit. After the properties are

identified, the students are given two additional circuits (Circuits 3 and 4) with a mixture of voltage and current sources.

As a group (of 4), the students should quickly determine which technique they believe will be best for Circuit 3 and which technique will be best for Circuit 4.
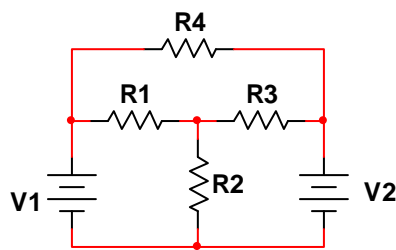
Students A & B, working together, develop the Node-Voltage equations for both circuits.
Students C & D, working together, develop the Mesh-Current equations for both circuits.
>   -if time allows, you can have them calculate the actual voltages and currents in
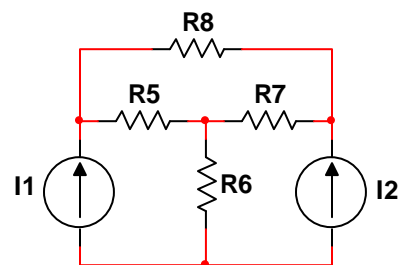>   the circuit

Again, the students gather as a group of 4 to discuss their results and answer:
>   - Were their predictions correct (which technique was best for each circuit)?
>   - If not, what might their prediction have been wrong?
>   - If yes, will their line of thinking extend to any circuit?
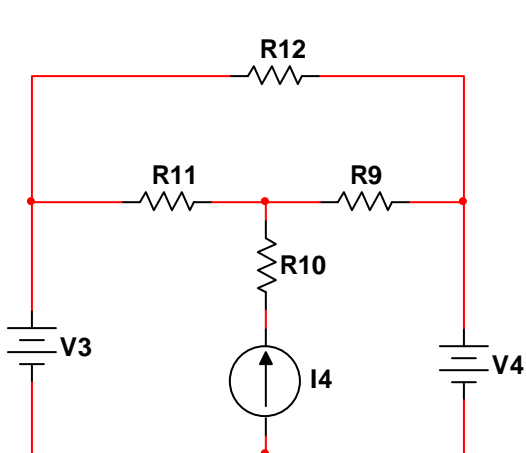
Instructor can again lead a discussion as to which circuit properties are the most helpful in determining the appropriate analytical technique to employ, based on the student experience.
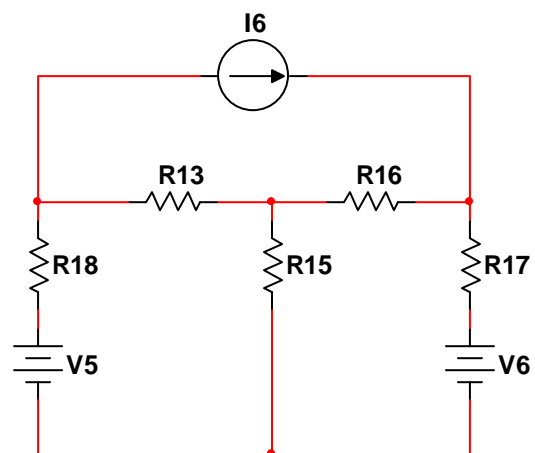
Circuit 1

Circuit 2

Circuit 3

Circuit 4

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