Assignment #2  Due today by 11:59 PM

Assignment #3 posted on Canvas
- Participation & Challenge activities from book
- Additional problems
  Exercises 3.1.4, 3.1.8, 3.1.11
  Submit scanned PDF file on Canvas

Monday: Recitation sections—please attend another section this week

Help sessions this week:  
Tu 6-7 pm  
Wed 6-7 pm  
ENGR 153

Lab #1 next week—Purchase lab supplies

\[ KCL \quad \text{(algebraic)} \quad \sum_{\text{node}} \text{current entering} = 0 \]
\[ i_1 + i_2 - i_3 = 0 \]
\[ -i_1 - i_2 + i_3 = 0 \]
\[ i_1 + i_2 = i_3 \]
\[ \sum_{\text{node}} \text{current entering} = \sum_{\text{node}} \text{current leaving} \]

\[ KVL \quad \text{(algebraic)} \quad \sum_{\text{loop}} \text{voltage across an element} = 0 \]
\[ v_1 + v_2 - v_3 = 0 \]
\[ \sum_{\text{loop}} \text{voltage rise} = \sum_{\text{loop}} \text{voltage drop} \]
\[ v_3 = v_1 + v_2 \]
Ex1 KVL:
\[ v_1 + 1V + 2V - 3V - 5V = 0 \]
\[ v_1 = 5V \]

Ex2
Loop 1:
\[ v_1 + 2V - 5V = 0 \]
\[ v_1 = 3V \]

Loop 2:
\[ -3V + v_2 - 2V = 0 \]
\[ v_2 = 5V \]

Large loop:
\[ 3V - 3V + 5V - 5V = 0 \] as expected

Series vs Parallel Connections

Parallel
Two elements are in parallel if they are connected to the same two nodes.

\[ i_1 + i_2 = i \]
\[ v_1 = v_2 \]

Series
Two elements are in series if they are connected sequentially (carry the same current) and share exactly one node.

Series connection of R_1 and R_2
KVL:
\[ v_1 + v_2 - v_3 = 0 \]
\[ v_3 = v_1 + v_2 = iR_1 + iR_2 \]

Ohm's Law
\[ v_1 = iR_1 \]
\[ v_2 = iR_2 \]
\[ v_3 = v_1 + v_2 = iR_1 + iR_2 = i(R_1 + R_2) = iR_{eq} \]
\[ v = i \cdot R_{eq} \quad R_{eq} = R_1 + R_2 \]

In general, the equivalent resistance of any number of resistors connected in series is the sum of the individual resistances:

\[ R_{eq} = R_1 + R_2 + R_3 + \ldots + R_n \]

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**Parallel Combination of Resistors**

\[ i_3 = i_1 + i_2 \]

Ohm's Law:

\[ v = v_1 R_1 = v_2 R_2 \]

\[ \Rightarrow \quad i_1 = \frac{v}{R_1}, \quad i_2 = \frac{v}{R_2} \]

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\[ i_3 = i_1 + i_2 = \frac{v}{R_1} + \frac{v}{R_2} = v \left( \frac{1}{R_1} + \frac{1}{R_2} \right) \]

\[ i_3 = \frac{v}{R_{eq}} \quad \Rightarrow \quad \frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} \]

Generalize to \( N \) resistors in parallel:

\[ \frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots + \frac{1}{R_N} \]

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Ex: \( i_3 \) ?

\[ I = \frac{12}{R_{eq}} \]

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\[ i_3 \] ?

\[ R_1 \quad 2 \Omega \quad 3 \Omega \quad \ldots \quad 5 \Omega \]

\[ R_2 \quad 6 \Omega \quad 4 \Omega \quad \ldots \quad 3 \Omega \]

\[ R_3 \quad 1 \Omega \quad \ldots \quad \]
\[ R_{eq1} = 4\Omega + 5\Omega + 3\Omega = 12\Omega \]
\[ \frac{1}{R_{eq2}} = \frac{1}{4} + \frac{1}{12} \]
\[ \frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} \Rightarrow R_{eq} = \frac{R_1 R_2}{R_1 + R_2} = \frac{4 \times 12}{4 + 12} = 3\Omega \]
\[ R_{eq3} = 3\Omega + 3\Omega = 6\Omega \]
\[ R_{eq4} = \frac{6 \times 6}{6 + 6} = 3\Omega \]
\[ R_{eq} = \frac{R_1 R_2}{R_1 + R_2} = \frac{R}{2} \]
\[ R_{eq5} = 2\Omega + 3\Omega + 1\Omega = 6\Omega \]

\[ I = \frac{12V}{6\Omega} = 2A \]
\[ \frac{10 \times 25}{10 + 25} = 2\Omega \]
\[ \frac{10 \times 15}{10 + 15} = 6\Omega \]
\[ R_{ab} = 2\Omega + 6\Omega = 8\Omega \]