Voltage Divider Rule & Current Divider Rule

EGR 220, Chapter 2
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Find \( R_{eq} \) and \( I \)

\[ \begin{align*}
R_{eq} &= \frac{V}{I} \\
I &= \frac{V}{R_{eq}}
\end{align*} \]

Circuit Analysis Techniques

- Review what we have done...
  - Bring questions to office hours
- Equivalent resistance, \( R_{eq} \)
  - Series and parallel resistors
- Current divider and voltage divider
- Mesh and nodal analysis
  - Building on KVL and KCL

Different \( R_{eq} \) for Different Terminals

We will discuss the role of \( V_s \) and \( I \), later (with Thevenin equivalent)
Voltage Divider Rule

- Resistors and elements in Series...
- Current or voltage is the same for \( R_1 \) & \( R_2 \)?
- Current or voltage is partitioned across \( R_1 \) & \( R_2 \)?
- Prove, or demonstrate, using KCL and KVL.

Voltage Divider: Series \( R \)

- Find \( v_1, v_2 \) in terms of \( v_{src}, R_1 \) & \( R_2 \)
  \( \rightarrow \) derive the expression
Voltage Divider: Series R

- Solve for $v_1$ and $v_2$
  - Which resistor will have the larger V drop?

Current Divider Rule

- Resistors, elements and branches in Parallel...
- Current Divider:
  - $I$ is partitioned, flowing through these resistors
  - What is the relationship of $V$ for each element?
  - Prove, or demonstrate, using KCL and KVL.

Current Divider: Parallel R

- Find $i_1$, $i_2$ in terms of $i_{src}$, $R_1$ & $R_2$
- Derive the expression...
Current Divider: Parallel R

- Solve for $i_1$ and $i_2$
  - Which R will carry the larger current?

\[\text{20 mA} \downarrow 6 \text{k}\Omega \downarrow 4 \text{k}\Omega \downarrow \]

I-Divider Discussion

\[120 \text{ V} \quad 20 \\Omega \quad 30 \\Omega \quad 40 \\Omega \quad 3 \text{ A}\]

Ammeter – Introduced Error

- Find the current $i$ in circuit (a).
- An ammeter with an internal resistance of 1 ohm is inserted in the network to measure $i'$ as shown in circuit (b). Does current, $i'$, increase or decrease relative to part (a)?

\[\text{4 V} \quad 40 \\Omega \quad 60 \\Omega \quad (a)\]

\[\text{4 V} \quad 40 \\Omega \quad 60 \\Omega \quad (b)\]
Voltmeter – Introduced Error

- Calculate the voltage \( V_o \) in circuit (a).
- Is the voltage \( V_o' \), measured when a voltmeter with 6-kΩ internal resistance is connected as in figure (b), greater or less than \( V_o \) in circuit (a)?

![Circuit Diagram](image)

Reminders for Lab & HW

- Labs
  - Eliminate (minimize) use of extra wire
    - Clip probes directly to resistor leads
  - Please be sure to neaten your lab station
    - Cables returned to the hanging racks
    - Elements to return bin at back of lab
- Homework
  - Please do one problem per page
  - Provide problem setup, to make the question and what you are solving very clear to all readers

Lab 2 – Lab equipment as part of your circuit

- Pre-lab 1: Explain why...
  - Ideal voltmeter \( R_m = \infty \) Ω
  - Ideal ammeter \( R_m = 0 \) Ω
- Pre-lab 2: Again explain why we want...
  - Ideal voltmeter \( R_m = \infty \) Ω
    - Think in terms of \( R_{eq} \) and effect of \( R_m \) on the circuit
Fundamental Analysis Tools for the Semester

- Basic analysis laws
  - Ohm’s law
  - KVL: Kirchhoff’s voltage law
  - KCL: Kirchhoff’s current law

- Analysis tools using the basic laws
  - Equivalent resistance
  - Current divider
  - Voltage divider
  - Mesh analysis
  - Nodal analysis
  - Equivalent Circuits