Review Mesh & Nodal, Introduce Linearity & Superposition

EGR 220, Chapter 4

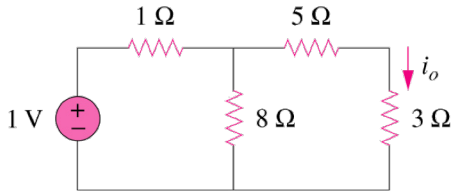
February 13, 2020

Overview

- Two new analysis techniques, for reducing complexity of circuits
  1) Linearity
  2) Superposition

Use linearity to solve for i_o

- How do we find i_o?
- What is i_o if V_s is 10V?
- What is the power consumed by the **load** in each situation?



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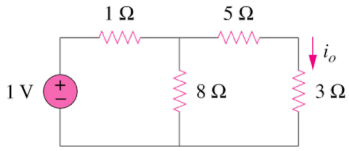


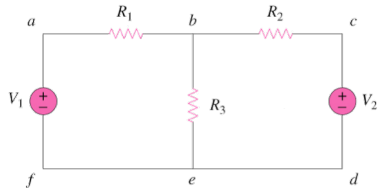
Setting Sources = 0

- If a current source = 0A, it acts as a(n):
  1) Short circuit?
  2) Open Circuit?

- If a voltage source = 0V, it acts as a(n):
  1) Short circuit?
  2) Open Circuit?

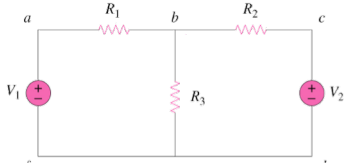
Superposition Warmup

- Could use nodal or mesh analysis
- *New technique* – **superposition**

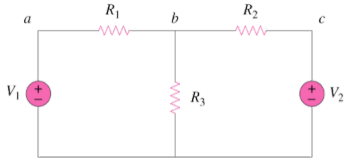


Superposition → Solve for each source, setting all other sources to a value of 0

Source 1



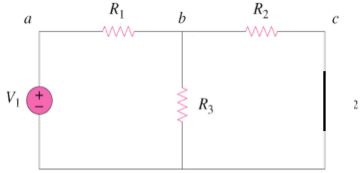
Source 2



Superposition

- Voltage divider

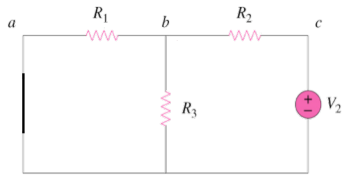
$V_{1R3} =$



Superposition

- Voltage divider

$V_{2R3} =$

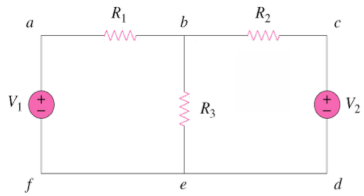


Superposition

- Voltage divider

$$V_{1R3} = V_1\left[\frac{(R_2||R_3)}{R_1 + R_2||R_3}\right]$$

$$V_{2R3} = V_2\left[\frac{(R_1||R_3)}{R_2 + R_1||R_3}\right]$$

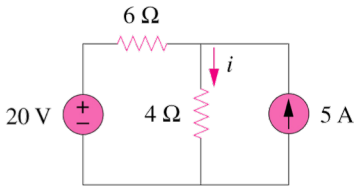


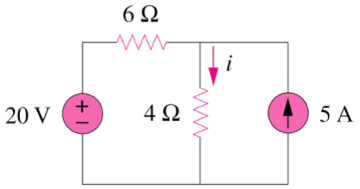
- Add the result contributed by each source for final value

$$V_{R_3} = V_{1R_3} + V_{2R_3}$$

Superposition

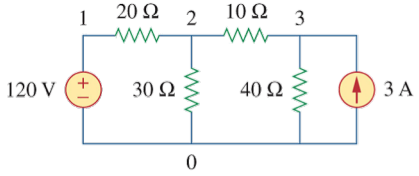
- How do we find *i* & $P_{4\Omega}$?
- * First set V_{src} = 0
- * Next set I_{src} = 0
- Since power ***is not*** linear, how do we find it?





Practice Circuit Analysis 1

- Find all currents and voltages



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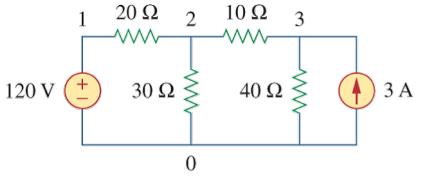
- Find all currents and voltages



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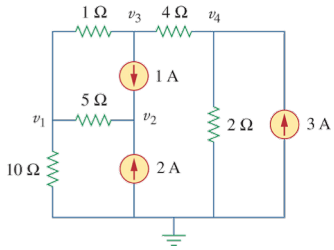
Discussion Circuit Analysis

- How can you find the voltages indicated?
- Compare ability to use nodal analysis vs. mesh analysis.



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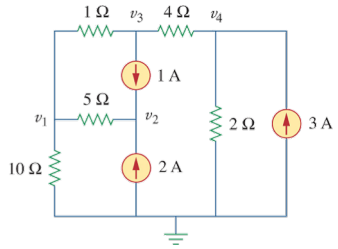
- How to find the voltages indicated?



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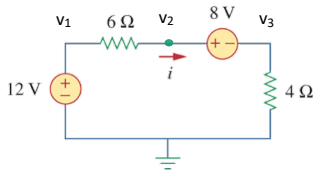
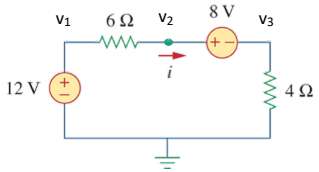
Practice Circuit Analysis 2

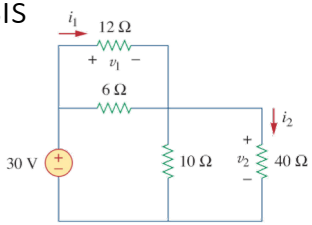
- Find all currents and voltages



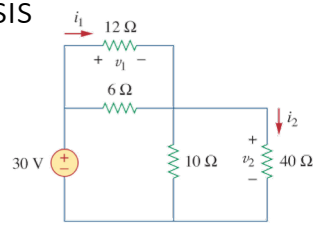
- Find all currents and voltages



Discuss Practice Analysis

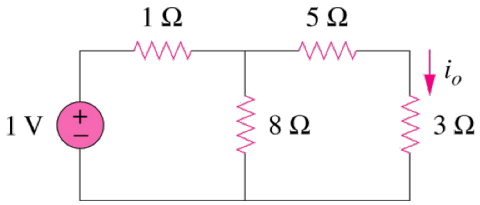


Discuss Practice Analysis

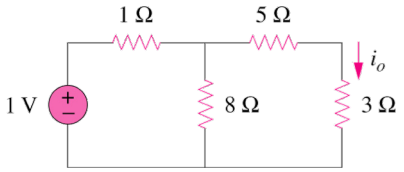


Practice Analysis (posted)

- How would we apply the tools learned so far?
  - KCL → Nodal analysis
  - KVL → Mesh analysis
  - Current or voltage divider with R_{eq}?



Practice Analysis



Analysis Tools

- Ohm's law
- KVL: Kirchhoff's voltage law
- KCL: Kirchhoff's current law
- Equivalent resistance
- Current divider
- Voltage divider
- Mesh analysis
- Nodal analysis

→ Exam 1 Through Mesh & Nodal; Linearity and Superpostion ←

- *Next core theorem:* Thevenin Equivalent Circuit

Important Notes

- Read the text book!
  - We have limited in-class time
- Check out the applets link
  - on webpage from the first week of class
- Homework
  - show and develop clear thinking
  - ***learn*** from the homework

Exam 1

- Next week during lab time, February 19
- All content through _____
- Spread yourselves across:
  1. Circuits lab room
  2. Adjoining conference room
  3. Room 146 at end of hall

Summary

- Circuit analysis tools
  - Nodal and mesh analysis, that use...
  - KVL and KCL to get simultaneous equations
  - Ohm's law to put equations into needed form
  - R_{eq} and voltage/current dividers if they help
- Today
  - Linearity
  - Superposition
- Next Thursday: **Thevenin** equivalent (& source transformation)
  - READ chapter