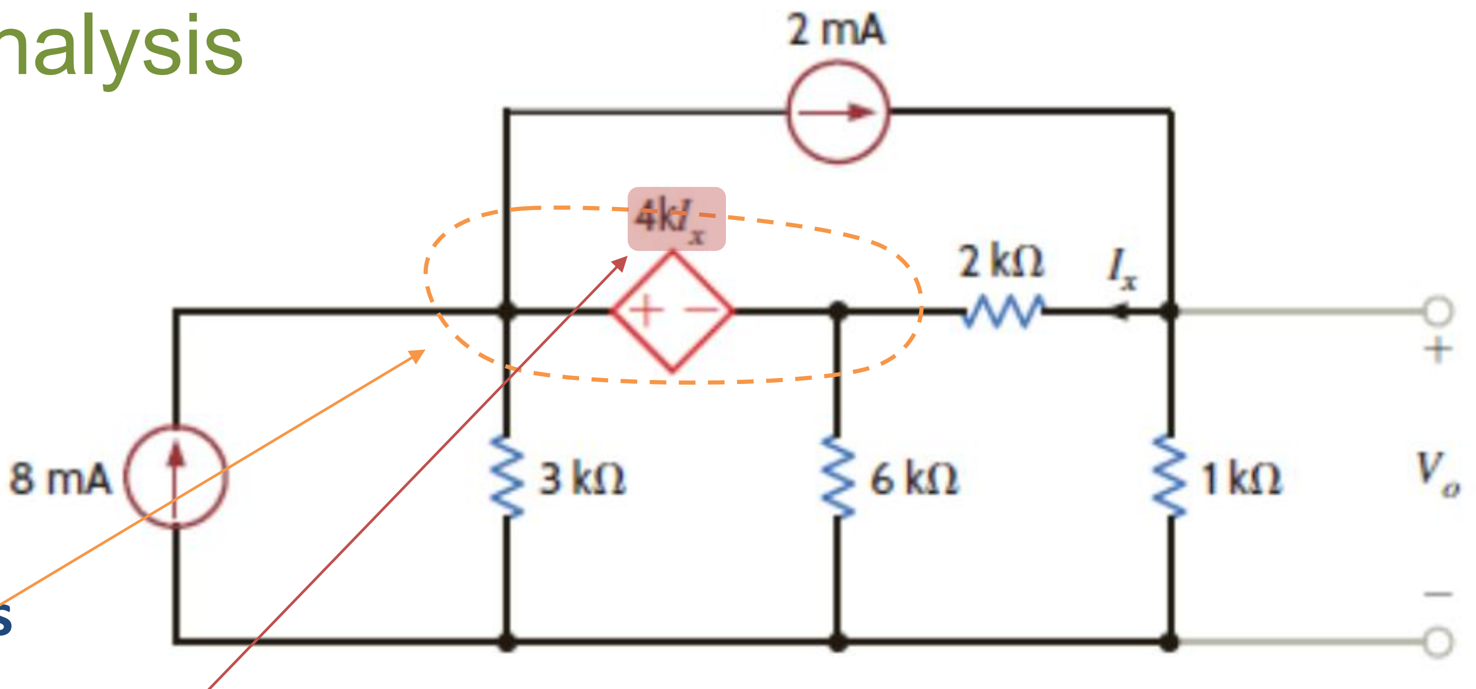
Exam #2 → ~~Thursday, February 14~~

Concepts Chapter #3: → Tuesday, February 21

1) Nodal Analysis
   - Select node as reference
   - # of Eq. = # of nodes – 1
   - variables → voltages
   - KCL → equations
   - voltage source → constraint eq. (express in terms of variables)
   - voltage source between 2 non-reference nodes → supernode
2) Loop Analysis
   - # of Eq. = # of independent loops
   - variables → currents (assign a loop current to each independent loop)
   - KVL → equations
   - current source → constraint eq. (express in terms of variables)

*** "Bate": bring your own set of equations (no problems, photocopies, solutions, etc)… subject to approval by the professor

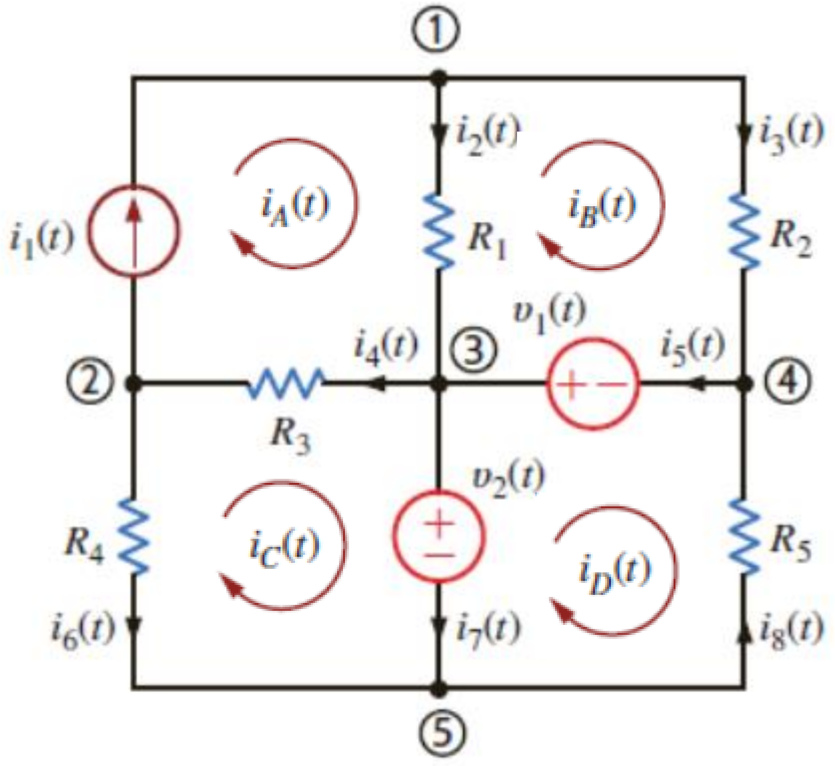
Last Lecture → Nodal Analysis



Analysis Procedure

1) Identify #of nodes
2) Select reference node
3) Label other node voltages
4) Identify branch currents
5) Identify supernode / dependent sources
6) Apply KCL to nodes and supernodes
7) Write constraint equation - supernodes → $V_1 - V_2 = 4k \cdot I_x$
8) Write controlling equation – dependent sources → $I_x = \frac{V_0 - V_2}{2k}$
9) Solve equation system

Mesh Analysis



Alternative # 1

- ***B → # of branches***
- ***N → # of nodes***
- ***B-N+1 → # independent simultaneous equations***

Alternative # 2

- ***M → # of independent loops in a planar circuit***
- ***M → # independent simultaneous equations***

B = 8 M = 4

N = 5

 # Eq. = 4

Stablish the currents around the loops

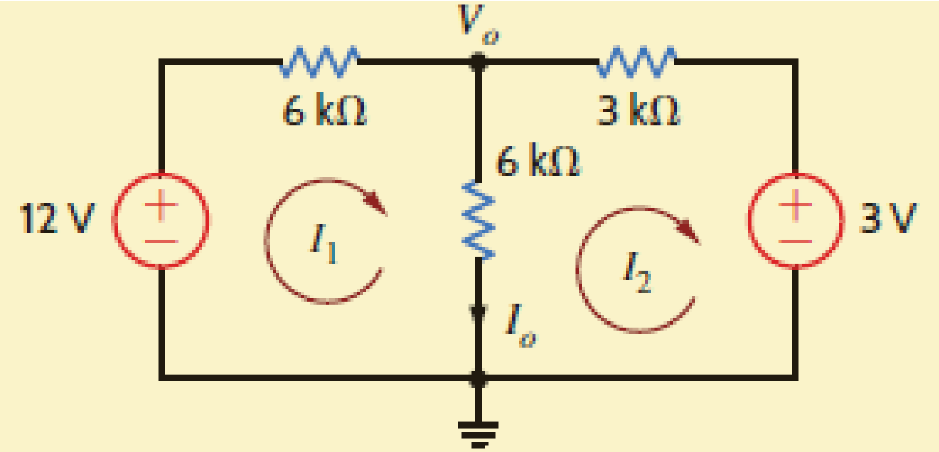
$$i_A(t) = i_1(t)$$
$$v_1 = V_{R_1} + V_{R_2}$$
$$-v_2 = V_{R_3} + V_{R_4}$$
$$v_2 - v_1 = V_5$$

Express voltages in terms of currents: $i_A(t)$, $i_B(t)$, $i_C(t)$, and $i_D(t)$

KVLs according to the current around the loop

Loop Analysis → with Independent Voltage Sources

***Use passive sign convention with respect the loop currents



M = 2

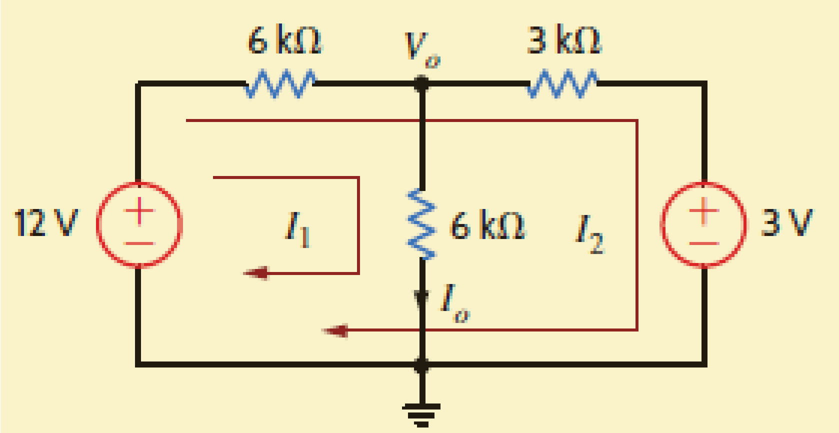
 # Eq. = 2

- KVLs in terms of I_1 and I_2

$$12 = 6k \cdot I_1 + 6k \cdot (I_1 - I_2)$$
$$-3 = 6k \cdot (I_2 - I_1) + 3k \cdot I_2$$

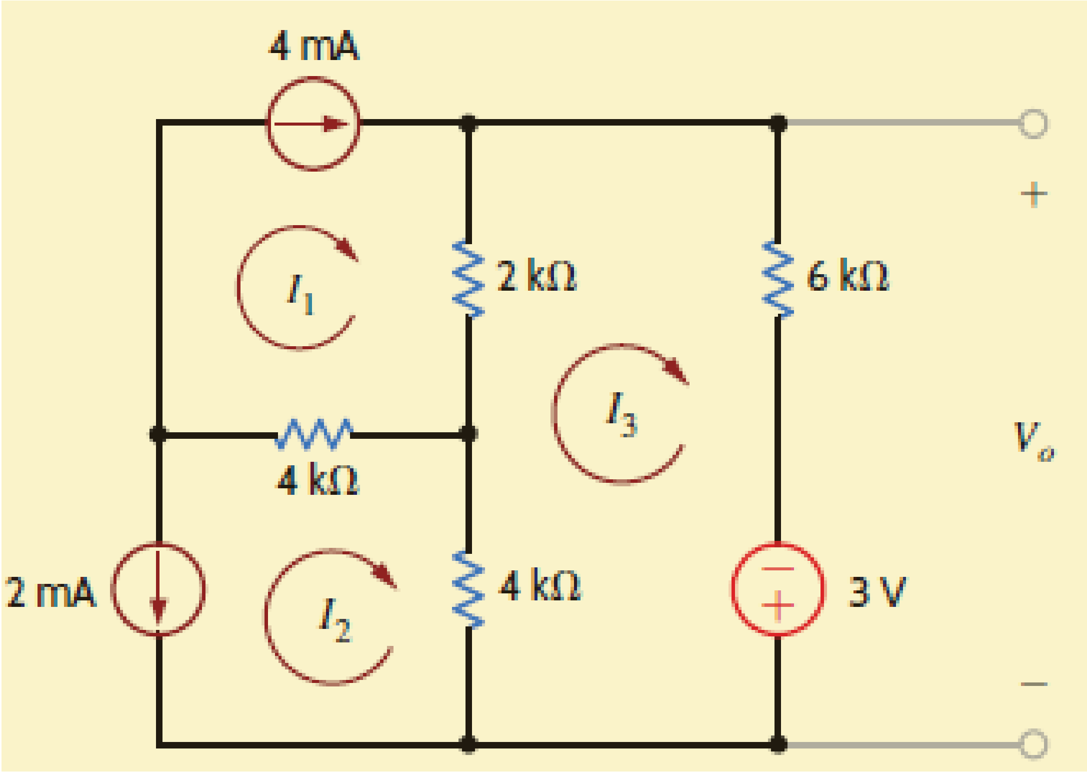
$$I_1 = \frac{1}{2} mA$$
$$I_2 = \frac{5}{4} mA$$

using the outer loop...



Loop Analysis → with Independent Current Sources

***** The current source will determine loop current**



M = 3

 # Eq. = 3

- **Independent CS**

  $$I_1 = 4mA$$
  $$I_2 = -2mA$$

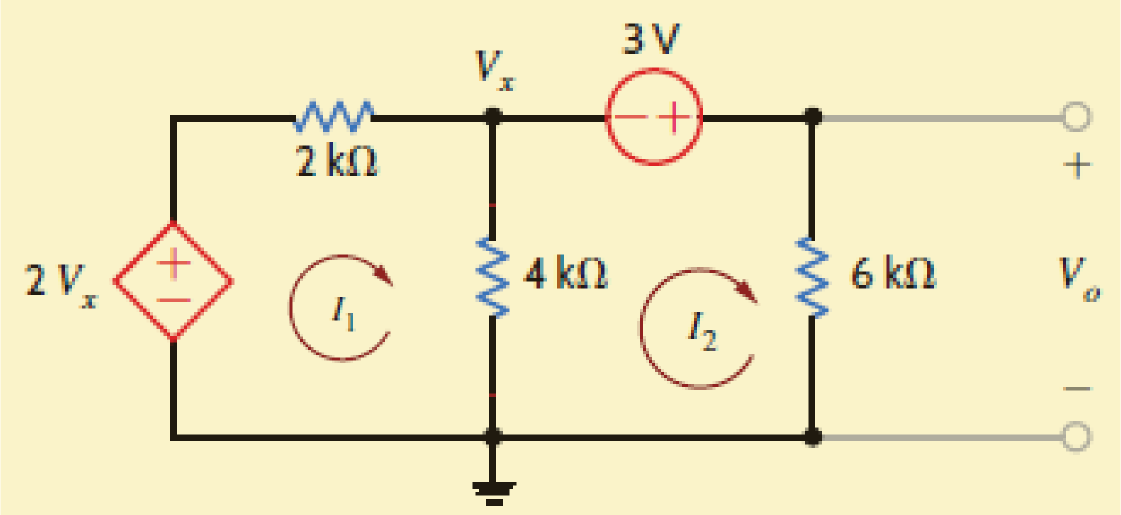
- **KVLs in terms of I_1, I_2, and I_3**

$$3 = 4k \cdot (I_3 - I_2) + 2k \cdot (I_3 - I_1) + 6k \cdot I_3$$

$$I_1 = \frac{1}{4} mA$$

Loop Analysis → with Dependent Voltage Sources

*** **After the KVLs, write the controlling equation for the dependent sources**



$M = 2$

$\# Eq. = 2$

- **KVLs in terms of I_1 and I_2**

$$2V_x = 2k \cdot I_1 + 4k \cdot (I_1 - I_2)$$
$$3 = 6k \cdot I_2 + 4k \cdot (I_2 - I_1)$$

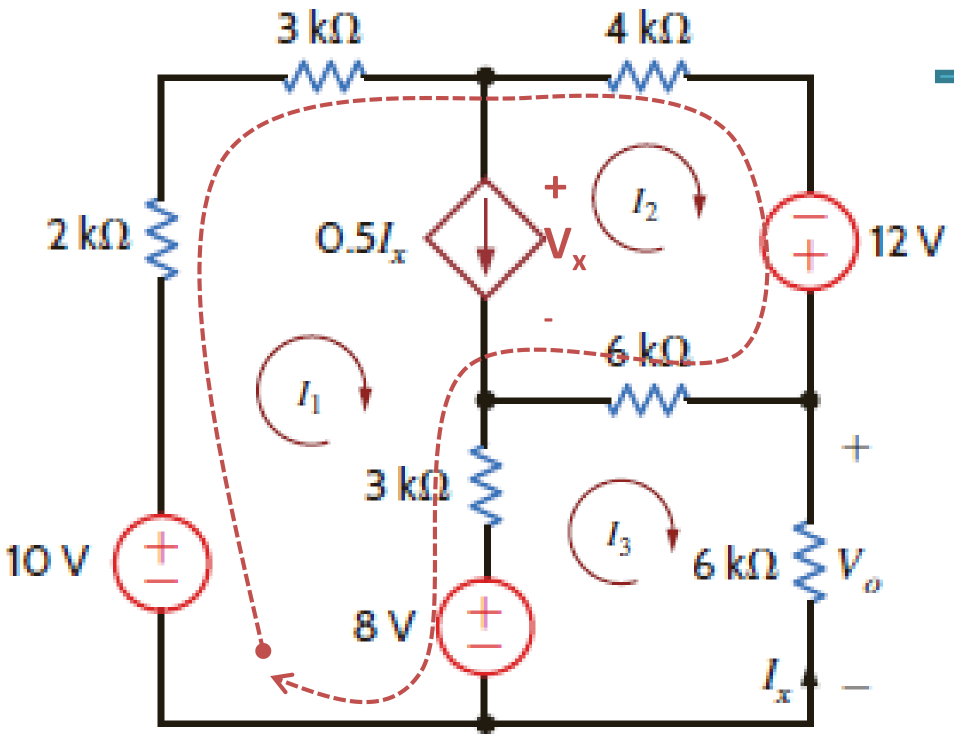
- **Controlling Eq.**

$$V_x = 4k \cdot [I_1 - I_2]$$

$$I_1 = 3mA$$
$$I_2 = \frac{3}{2}mA$$
$$V_0 = 9V$$

Loop Analysis → Super-mesh

Learning Assessment – E3.23: Find V_o.



M = 3

 # Eq. = 3

- **KVLs in terms of I_1, and I_2**

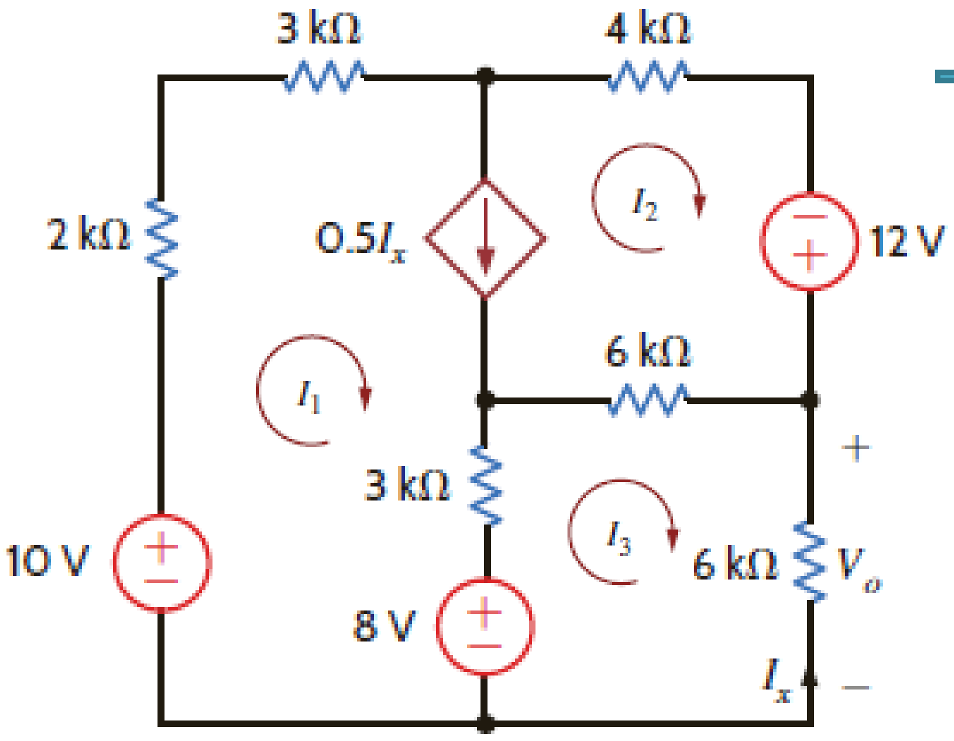
$$10 - 5k \cdot I_1 - V_x - 3k \cdot (I_1 - I_3) - 8 = 0$$
$$12 - 6k \cdot (I_2 - I_3) + V_x - 4k \cdot I_2 = 0$$

- **KVLs @ Super-mesh**

$$10 - 5k \cdot I_1 - 4k \cdot I_2 + 12 - 6k \cdot (I_2 - I_3) - 3k \cdot (I_1 - I_3) - 8 = 0$$

Loop Analysis → Super-mesh

Learning Assessment – E3.23: Find V_o.



M = 3

Eq. = 3

- **KVLs in terms of I_1, I_2 and I_3**

$$14 = 8k \cdot I_1 + 10k \cdot I_2 - 9k \cdot I_3$$

$$8 = -3k \cdot I_1 - 6k \cdot I_2 + 15k \cdot I_3$$

- **Controlling Eq.**

$$I_x = -I_3$$

- **Dependent CS**

$$I_1 - I_2 = \frac{1}{2} I_x$$

$$I_1 = \frac{10}{9} mA$$

$$I_3 = \frac{3}{2} mA$$

$$V_0 = 9V$$